





INSTRUCTION MANUAL MODEL 514 and 514A

PULSE/FUNCTION GENERATOR



EXACT

® Box 347 Tillamook OR 97141
Telephone 503-842-8441
TWX 510-590-0918

electronics, inc.

EXACT ELECTRONICS, INC.

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IF YOUR INSTRUMENT DOES NOT OPERATE PLEASE

1. Check operating procedure in manual for proper setup.
2. Check fuse and power supply voltages.
3. Call your Exact representative or factory. Instruments returned to the factory will be accepted only if they are sent freight prepaid, unless Exact or factory representative has authorized otherwise.

CLAIM FOR DAMAGED SHIPMENT

The instrument should be inspected as soon as received. If damage has occurred, a claim should be made with the carrier. The claim agent should receive a complete report of damage and a copy sent to Exact. After receiving this report, Exact will advise you of the disposition of the instrument and arrange for its repair or replacement.

WARRANTY

Exact warrants its instruments to be free from defects in material and workmanship under normal use for a period of twelve months from the original date of shipment. Exact's obligation is limited to repair or replacement.

All repairs and replacements made under this warranty are f.o.b. Exact's factory or designated service depot unless otherwise authorized by Exact. This warranty is made on condition that prompt notice of defect is given to Exact, in writing, within the warranty period and that Exact shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any instrument which has been repaired or altered by other than Exact's own service representative so as, in Exact's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been operated contrary to sound practice or operating instructions.

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SECTION 1

SPECIFICATIONS

1.1 SPECIFICATIONS

WAVEFORMS

Sine, triangle, square, +square, -square, pulse, -pulse, delayed pulse, TTL, $\overline{\text{TTL}}$. 514A adds ECL and $\overline{\text{ECL}}$.

MODES OF OPERATION

Run, variable symmetry, gate, trigger, pulse, double pulse, delayed pulse.

FREQUENCY RANGE

0.001 Hz to 5 MHz function generator.

0.001 Hz to 10 MHz pulse generator.

(20 MHz in double pulse mode).

FREQUENCY ACCURACY

(Multiplier switch settings from 1.0 to 10).

(1% of setting plus 1% of full scale) 10 Hz to 1 MHz.

(2% of setting plus 2% of full scale) 0.1 Hz to 10 Hz and 1 MHz to 5 MHz.

HIGH OUTPUT

50 Ohm output impedance.

Sine, triangle, square: 20V P-P into open circuit, 10V P-P into 50 Ohms.

+square, -square, pulse, 10V Peak into open circuit, 5V Peak into 50 Ohms.

LOW OUTPUT (514)

50 Ohm output impedance.

Sine, triangle, square: 2V P-P into open circuit, 1V P-P into 50 Ohms.

+square, -square, pulse, 1V into open circuit, 0.5V peak into 50 Ohms.

40 dB attenuator varies high and low output simultaneously.

ATTENUATOR (514A)

60 dB in 10 dB steps plus 20 dB continuously variable (80 dB total).

Replaces low output on Model 514.

DC OFFSET

Variable, switched in and out with pushbutton.

+10V to -10V open circuit, +5V to -5V into 50 Ohms.

SQUARE WAVE, PULSE

Rise and fall times: < 40 nSec.

Overshoot and ringing: < 5% of maximum P-P voltage.

TTL OUTPUTS

Approximately 3V Peak will drive 50 Ohm load. Normal and Complement available simultaneously. Typical rise time, 8 nSec.

1.1 SPECIFICATIONS (continued)

ECL OUTPUTS (514A)

Approximately $-0.9V$ to $-1.7V$ typical. Will drive 50 Ohms terminated to $-2V$. Normal and Complement available simultaneously. Typical rise time, 3 nSec.

DOUBLE PULSE

Spacing set by DELAY control. Minimum possible spacing between double pulse leading edges is equivalent to at least 50 MHz.

SYMMETRY (TIME)

$\pm (1\% + 10 \text{ nSec})$. Variable symmetry off.
1 Hz to 5 MHz.

SINE DISTORTION

$< 0.5\%$ 1 Hz to 100 kHz.
No harmonics $< 30 \text{ dB}$ down 100 kHz to 5 MHz.

SINE FREQUENCY RESPONSE

$< 0.2 \text{ dB}$ to 500 kHz.
 $< 1 \text{ dB}$ to 5 MHz.

TRIANGLE NON-LINEARITY

$< 1\%$ (Best straight line method) 1 Hz to 100 kHz.

MAIN SYNC OUTPUT

Square wave, approximately 4V Peak. 50 Ohms output impedance.
TTL compatible.

VCF RANGE

Approximately 0V to 5V input for 1,000:1 frequency control.

FREQUENCY STABILITY

0.05% of setting for 10 minutes.
0.25% of setting for 24 hours.

AMPLITUDE STABILITY

0.05% of max P-P amplitude for 10 minutes.
0.25% of max P-P amplitude for 24 hours.

SYMMETRY CONTROL

Continuously variable from 19:1 to 1:19. The generator frequency is divided by an approximate factor of 10 when operating in this mode.

GATE AND TRIGGER

Requirements: Manual or external voltage. Input: DC coupled, 2K Ohms input impedance. TTL Gate/Trig level.

1.1 SPECIFICATIONS (continued)

POWER REQUIREMENTS

117 VAC $\pm$ 10% (Other voltages available).

50 Hz to 400 Hz.

Approximately 45 Watts.

PHYSICAL CHARACTERISTICS

31.8 cm wide x 12.7 cm high x 27.9 cm deep.

Weight: approximately 5.5 kg.

NOTE: Unless otherwise stated specifications apply 10% to maximum output voltage terminated into 50 Ohms and do not apply at frequency settings less than 1.0 times the RANGE-HZ/PER switch. Specifications valid at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ at constant mains voltage after a 30 minute warm-up period. Function generator specifications only apply with the Pulse Width switch in the off position. Specifications are subject to change without notice.

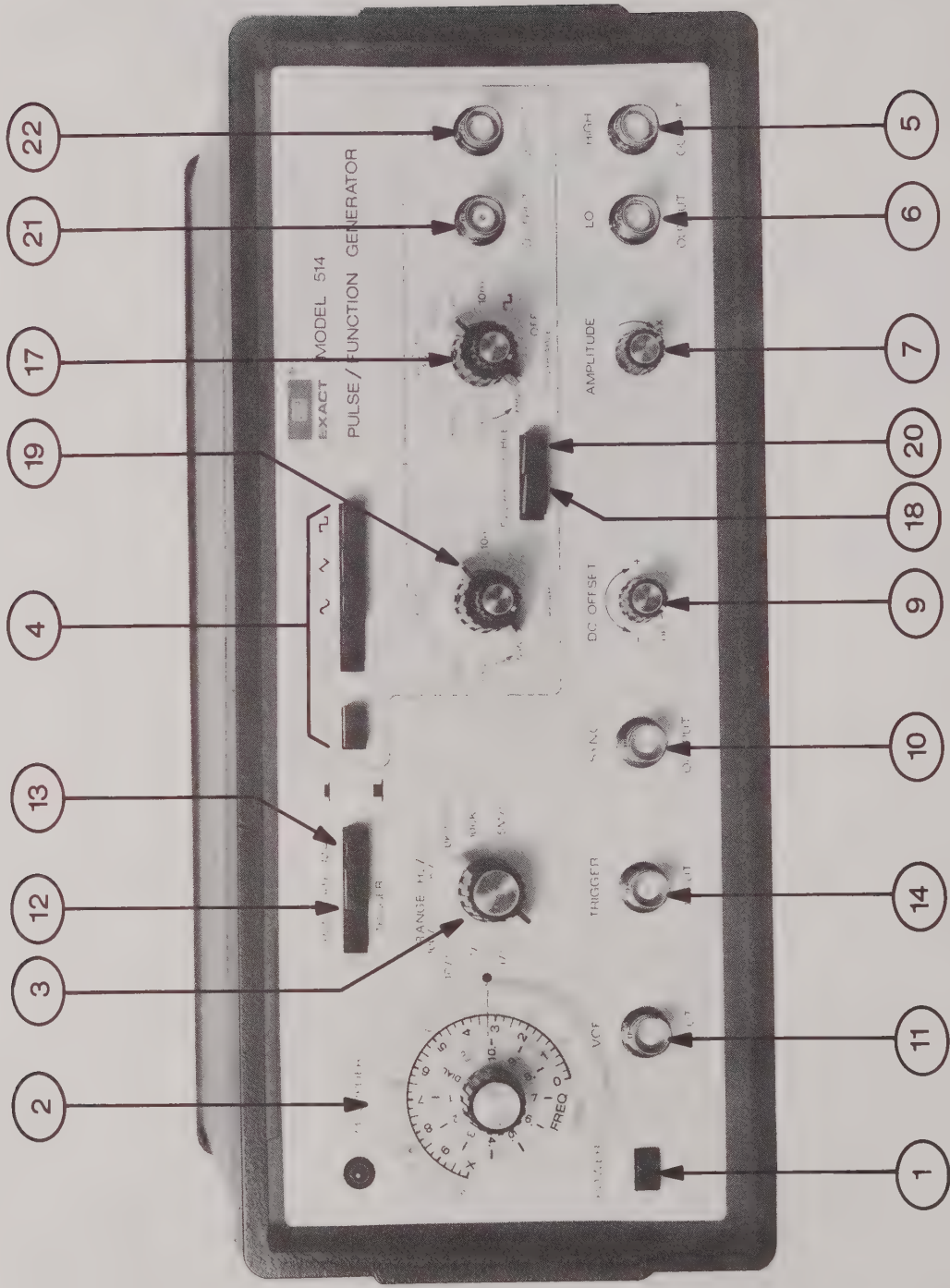
OPTIONS

K. 600 OHM OUTPUT IMPEDANCE

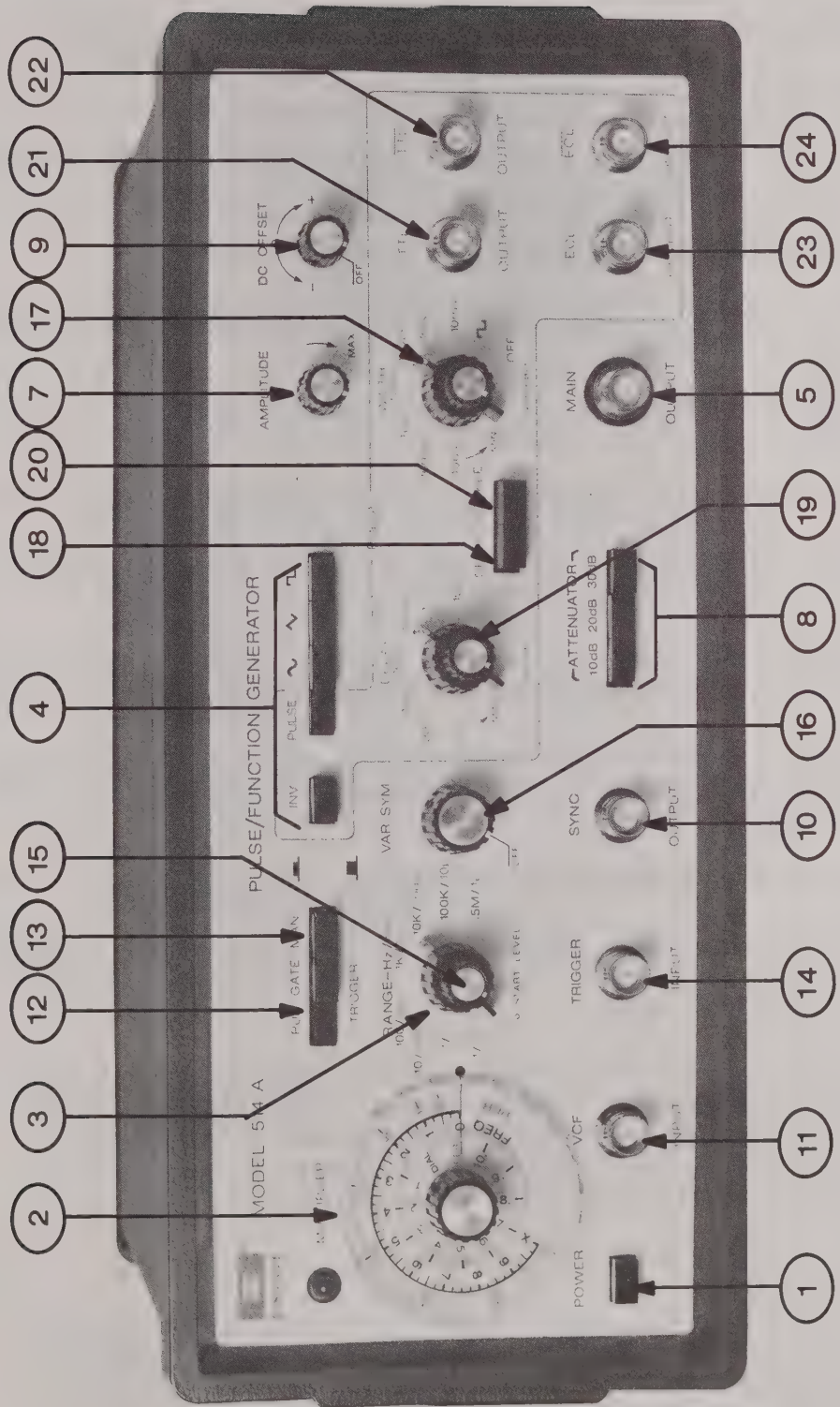
The following do not apply with 600 Ohm output: Square rise time, overshoot and ringing, sine frequency response, and sine distortion above 100 kHz.

SECTION 2

OPERATING INSTRUCTIONS



FRONT PANEL FAMILIARITY



FRONT PANEL FAMILIARITY

2.1 OPERATING INSTRUCTIONS

Refer to Front Panel Familiarity.

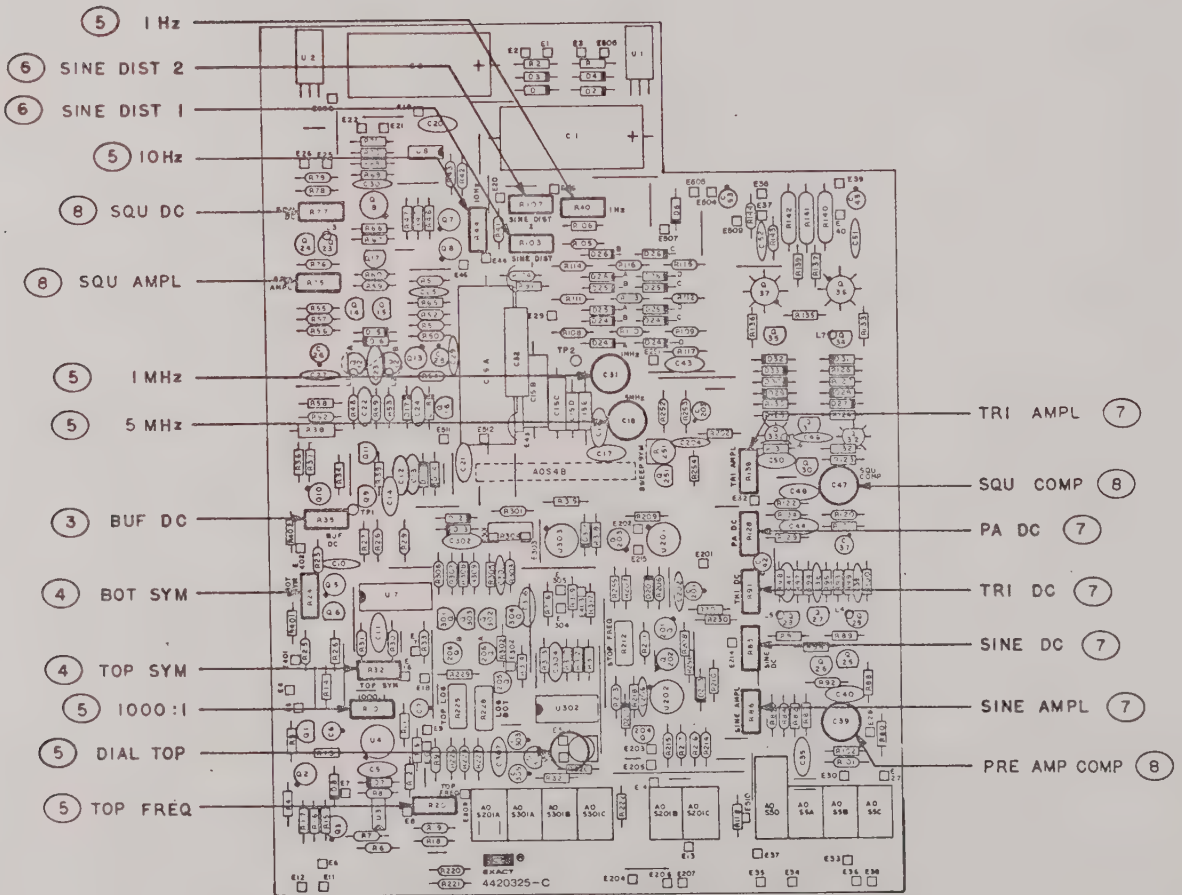
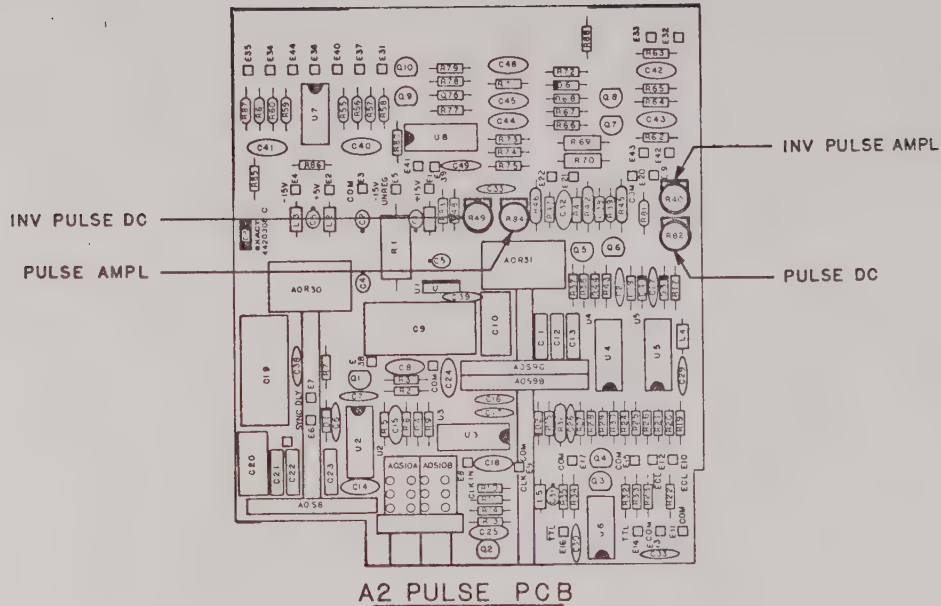
1. **POWER.** Turns on power to the instrument.
2. **MULTIPLIER.** Sets the frequency or pulse repetition rate at which the generator runs. Its value is multiplied by the RANGE-HZ/Sec setting.
3. **RANGE-HZ/Sec.** Sets the decade range for the MULTIPLIER.
4. **FUNCTION.** Selects the output waveform. Sine, triangle, square waves, and $\pm$ pulses are available.
5. **HI OUTPUT (MAIN OUTPUT).** Main output $\pm 10V$ open circuit and $\pm 5V$ into 50 Ohms.
6. **LO OUTPUT (514 only).** $\pm 1V$ open circuit and $\pm .5V$ into 50 Ohms.
7. **AMPLITUDE.** Sets the peak to peak amplitude of the Hi and LO OUTPUT continuously over a 20 dB range.
8. **STEP ATTENUATOR (514A only).** Provides 60 dB of attenuation in 10 dB steps in addition to the 20 dB provided by the AMPLITUDE control (80 dB total).
9. **DC OFFSET.** Sets the DC level of the output within the limits of the maximum output levels. This may be shut off by rotating the control counterclockwise through the detent.
10. **SYNC OUTPUT.** A 0-4V square wave coincident with the main outputs.
11. **VCF IN.** Voltage controlled frequency input. Allows for externally selecting the frequency or sweeping. Approximately 0-5 volts covers the range of the MULTIPLIER control.
12. **RUN/GATE/TRIG.** Sets the run mode. With RUN depressed, the instrument continuously runs at the frequency selected. With GATE depressed and RUN released, the instrument will run continuously as long as a trigger signal is present. With both RUN and GATE released, the instrument outputs one cycle for each trigger signal received.
13. **MAN.** For manually gating or triggering the instrument.
14. **TRIG IN.** For externally gating or triggering. When the applied signal goes above approximately 1.4V the instrument is triggered. The signal must go below approximately 1.3V to remove the triggered condition. The voltage should not be allowed to be greater than $\pm 12V$.

2.1 OPERATING INSTRUCTIONS (continued)

15. START LEVEL (514A on). Vary the start phase of sine and triangle waves from -90° to $+90^\circ$.
16. VARIABLE SYMMETRY (514A only). Continuously varies symmetry from 19:1 to 1:19. The generator frequency is divided by approximately 10 in this mode.
17. PULSE WIDTH. Sets the pulse width from less than 10 nSec to greater than 100 mSec in 7 decade ranges and VARIABLE between ranges.
18. DELAY. Activates the DELAY time controls.
19. DELAY TIME. Sets the delay time from less than 10 nSec to greater than 100 mSecs. The delay time is the time between the positive transition of the SYNC OUT pulse and the beginning of the pulse.
20. DOUBLE. Generates 2 pulses of equal length. The first one is coincident with SYNC OUT and the second one occurs after the DELAY.
21. TTL OUTPUT. Outputs TTL pulse (approximately .4V to 3.4V) as set by the pulse controls. Will drive 50 Ohm load.
22. $\overline{\text{TTL}}$ OUTPUT. Outputs inverted TTL pulses (approximately 3.4V to .4V). Will drive 50 Ohm load.
23. ECL OUTPUT (514A only). Outputs ECL pulses (approximately -1.7V to -.9V) as set by the pulse controls. Will drive 50 Ohm load to -2V.
24. $\overline{\text{ECL}}$ OUTPUT. Outputs inverted ECL pulses (approximately -.9V to -1.7V). Will drive 60 Ohm load to -2V.

SECTION 3

CALIBRATION PROCEDURE



ADJUSTMENT LOCATION DETAILS

3.1 CALIBRATION PROCEDURE

1. EQUIPMENT REQUIRED

Oscilloscope: 0 - 50 MHz with differential comparator input.
Counter-Timer: 1 Hz to 5 MHz with time interval A to B.
Distortion Analyzer: < 0.1% residual distortion.

2. INITIAL CONTROL SETTINGS

RUN	ENGAGED
GATE	DISENGAGED
RANGE-HZ/Sec	1K
WAVEFORM	
DC OFFSET	OFF
AMPLITUDE	MAX CS
WIDTH	10 μ S
WIDTH VARIABLE	CCW
DELAY	OFF
DOUBLE	OFF

3. BUFFER OFFSET

- A. Connect the oscilloscope to TP 1.
- B. Adjust BUF DC ADJ for the triangle to be symmetrical about $0V \pm 100$ mV.

4. TIME SYMMETRY

- A. Connect MAIN OUTPUT to counter-timer.
- B. Set counter-timer to measure time interval.
- C. Set MULTIPLIER for a reading of approximately 75 μ Sec.
- D. Alternately switch the counter-timer to measure the two halves of the waveform separately (positive slope to negative slope, the negative slope to positive slope).
- E. Adjust TOP SYM ADJ for both halves to be the same $\pm .1\%$ (± 15 nSec).
- F. Set MULTIPLIER for a reading on the counter of approximately 5 mSec. If it will not adjust low enough in period, use the 1000:1 ADJ.
- G. Adjust BOT SYM ADJ as in step D and E above.
- H. Repeat steps C through G until no more improvement can be obtained.

3.1 CALIBRATION PROCEDURE (continued)

5. FREQUENCY

- A. Set MULTIPLIER inner dial to DIAL and outer dial fully counterclockwise.
- B. Set the counter to measure frequency (or period for low frequency adjustment).
- C. Adjust 1000:1 ADJ for a frequency of $8 \text{ Hz} \pm .8 \text{ Hz}$ ($125 \text{ mSec} \pm 12 \text{ mSec}$).
- D. Set MULTIPLIER inner dial to 10 and outer dial to 0.
- E. Adjust TOP FREQ ADJ for 10 kHz.
- F. Set MULTIPLIER inner dial to DIAL and outer dial to X.
- G. Adjust DIAL TOP ADJ for 10 kHz.
- H. Set MULTIPLIER inner dial to 10 and outer dial to 0.
- I. Set RANGE-HZ/Sec to .1.
- J. Adjust 1 Hz FREQ ADJ for $1 \text{ Hz} \pm .01 \text{ Hz}$ ($1 \text{ Sec} \pm 10 \text{ mSec}$).
- K. Set RANGE-HZ/Sec to 1.
- L. Adjust 10 Hz ADJ for $10 \text{ Hz} \pm .1 \text{ Hz}$ ($.1 \text{ Sec} \pm 1 \text{ mSec}$).
- M. Set RANGE-HZ/Sec to 100 k.
- N. Adjust 1 MHz ADJ for $1 \text{ MHz} \pm 10 \text{ kHz}$.
- O. Set RANGE-HZ/Sec to .5 M.
- P. Adjust 5 MHz ADJ for $5 \text{ MHz} \pm 50 \text{ kHz}$.

6. SINE DISTORTION

- A. Set WAVEFORM to SINE.
- B. Set RANGE-HZ/Sec to 1 k.
- C. Set MULTIPLIER to 10.0.
- D. Connect MAIN OUTPUT to Distortion Analyzer.

3.1 CALIBRATION PROCEDURE (continued)

- E. Adjust SINE DIST 1 for minimum distortion.
- F. Adjust SINE DIST 2 for minimum distortion.
- G. Repeat steps E and F until no more improvement can be obtained.

7. OUTPUT LEVELS

- A. Connect MAIN OUTPUT to oscilloscope terminated into 50 Ohms.
- B. Turn AMPLITUDE fully counterclockwise.
- C. Set WAVEFORM to TRIANGLE.
- D. Adjust PA DC for $0V \pm 10 \text{ mV}$.
- E. Turn AMPLITUDE fully clockwise.
- F. Adjust TRI DC for the triangle peaks to be equal voltages $\pm 10 \text{ mV}$.
- G. Adjust TRI AMPL for the triangle peaks to be $5.1V \pm 50 \text{ mV}$.
- H. Set WAVEFORM to SINE.
- I. Adjust SINE DC ADJ for both sine peaks to be the same voltage $\pm 10 \text{ mV}$.
- J. Adjust SINE AMPL ADJ for sine peaks of $5.1V \pm 50 \text{ mV}$.
- K. Set WAVEFORM to SQUARE.
- L. Adjust SQU DC ADJ for the positive peak to be $5.1V \pm 50 \text{ mV}$.
- M. Adjust SQU AMPL ADJ for the negative peak to be $5.1V \pm 50 \text{ mV}$.
- N. Set WAVEFORM to PULSE and engage INV.
- O. Adjust INV PULSE DC for $0V \pm 10 \text{ mV}$.
- P. Adjust INV PULSE AMPL for $5.1V \pm 50 \text{ mV}$.
- Q. Disengage INV.
- R. Adjust PULSE DC for $0V \pm 10 \text{ mV}$.
- S. Adjust PULSE-AMPL for $5.1V \pm 50 \text{ mV}$.

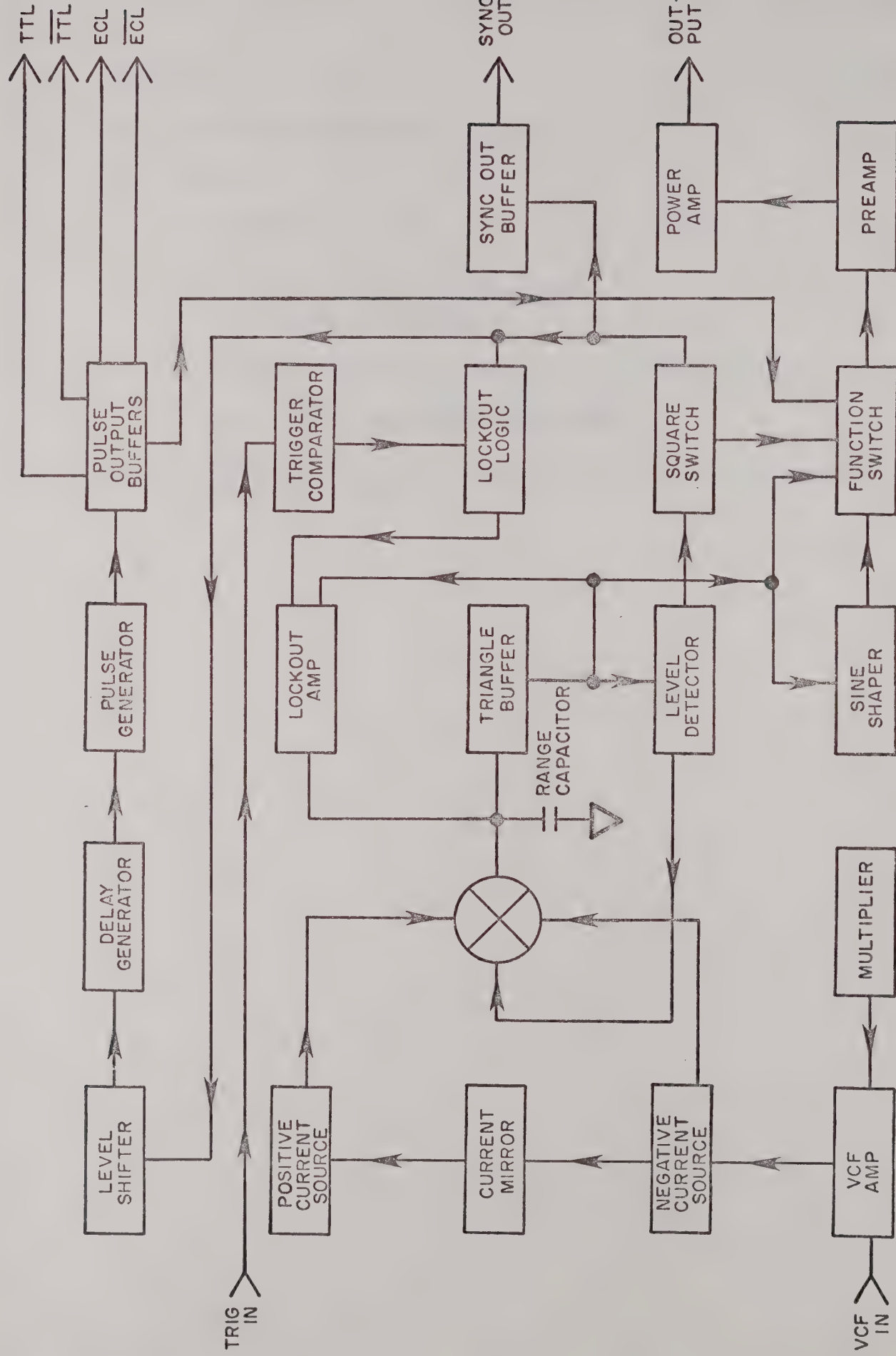
3.1 CALIBRATION PROCEDURE (continued)

8. RISE TIME

- A. Set MULTIPLIER to 7.0.
- B. Set RANGE/HZ/Sec to 100 k.
- C. Set WAVEFORM to SQUARE.
- D. Adjust PA COMP for maximum rise time with minimum overshoot.
- E. Adjust PREAMP COMP for minimum ringing.
- F. Repeat steps D and E for best looking waveform with < 40 nSec rise time and $< 5\%$ overshoot.

SECTION 4

CIRCUIT DESCRIPTION



BLOCK DIAGRAM

4.1 CIRCUIT DESCRIPTION

POWER SUPPLIES

The ± 20 Volt unregulated supplies to power the power amplifier are generated from the transformer T1, full wave bridge D1 through D4 and filter caps C1 and C2. The ± 12 Volt regulated supplies are composed of two terminal regulators U1 and U2 which regulate the ± 20 Volt supplies down to ± 12 Volts.

MAIN GENERATOR LOOP

0 to +5 VDC is applied at the VCF input R9, or at R8, or R221 from the MULTIPLIER. These currents are summed at pin 3 of U4 together with a small current from the 1000:1 calibration adj. The +1 Volt to +7 Volt at the output of U4 is level shifted by Q1 to be -11.5 to -6.5 Volts at the bases of U7A, B, and C. The current through U7B and C tracks that through U7A. U7C is the negative current source for the timing capacitor, while U7B is part of the current mirror for the positive current source. The resistive current divider R18, 19, and 20 provides linear feedback from the collector of U7A to the + input at U4. This divider reduces the current applied to the + input of U4 while allowing the collector current of U7A to equal that of the negative current source of U7C. Equalizing these currents provides maximum precision by utilizing equal operating points. The positive current source is obtained by the current mirror U7E. Tracking is accomplished with negative feedback provided by Q5 and Q6. U7D provides the positive current source by matching the current in the current mirror. These two current sources are alternately sunk by the level detector through diode bridge D11, 12, 13, and 14, allowing the other source to linearly charge the range selected timing capacitor, C15. Q9, Q10, and Q11 are a unity gain buffer with a very high input impedance. This buffer prevents loading of the current sources to provide a very linear triangle. The input stage, FET Q9, is a source follower, and Q11 is an emitter follower. The Level Detector-Bistable Switch, Q12 is a differential amplifier with Q13 providing a constant current. The reference levels, $\pm .5$ V, at the base of Q12B are determined by R53, R54, and R55 depending upon the state of diode bridge D17 and D18. D15 and D16 limit the collector voltage excursions to maximize high frequency response. The Level Detector collectors differentially drive a non-saturating current-mode switch, Q14 and Q15. One switch output, Q15, drives the Level Detector reference gate and the Current Source bridge. The SYNC OUTPUT is provided by Q17 level shifting to TTL levels Q18 buffering.

CAPACITANCE MULTIPLIER

U8 is a capacitance multiplier used on the 1 Hz range only. It inverts and amplifies the triangle to ± 9 V. This is applied to the opposite end of the 10 μ F timing capacitor and makes it appear to be a 100 μ F capacitor.

4.1 CIRCUIT DESCRIPTION (continued)

SINE CONVERTER

The Sine Converter converts the triangle to a sinewave with a bipolar diode shaping network. The triangle is applied directly to the three diode bridges, D24, D25, and D26. As the triangle rises, each diode bridge will switch in succession, causing the output of the network to form a sinewave.

PREAMPLIFIER

The preamplifier is a non-inverting closed loop amplifier. Q25 and Q26 form the differential input stage providing DC stability. Q28 forms the second gain stage with Q27 providing the collector of Q28 with a high impedance for increased gain. Q29 buffers the second stage and is the output. Feedback is through R101.

POWER AMPLIFIER

The power amplifier works much like the preamplifier except that it is inverting and the second gain stage is buffered by Q34 and Q35 prior to the output stage Q36 and Q37.

LOCKOUT

The generator is stopped, or locked out by removing the timing current from the timing capacitor C15. Q302 and Q303 form a differential amplifier with the voltage at the base of Q302 being the lockout voltage. The base of Q303 is connected to the output of the triangle buffer. When the triangle reaches the lockout voltage, Q303 is turned on and the timing current is taken away from the capacitor. Q301 is a current source tracking the positive current source keeping the lockout level at the same voltage independent of timing current. Lockout is disabled by pulling the emitters of Q302 and Q303 to 0V. This is done by the lockout flip-flop U302C and D. This is a set-reset type flip-flop receiving signals from the trigger comparator and the level detector to enable and disable lockout. U303 is the trigger comparator. It is a differential comparator set to switch at 1.4V with 100 mV of hysteresis. This shapes the incoming trigger signals to levels suitable to drive the flip-flop. U302A and B form a switch debouncer for the manual trigger switch.

PULSE GENERATOR (A2)

The pulse generator is triggered from the main generator level detector signal at A0 Q16. Q7 and Q8 level shift the signal from the level detector to ECL levelers and speed up the rise and fall times. A short pulse, < 10 nSec, is generated at U8 pin 7 at the positive transition of the level detector signal. In the 5 MHz range, Q10 is turned off and a pulse is also generated at the negative transition of the level detector, thus doubling the frequency. This signal is routed through the mode switch to the WIDTH generator, U3 and Q2. The time is set by capacitor C9 through C13 and R16. The current from

4.1 CIRCUIT DESCRIPTION (continued)

R16 changes the selected capacitor. Q2 senses the capacitor voltage and at +3.3 switches U3 to reset the capacitor voltage to 4.1V. U7 forms a capacitance multiplier to effectively multiply C9 to 100 μ F for the lowest range. The Delay generator U2 and Q1 operates the same as the Width generator. U4, U5, and U6 level shift and buffer the pulse to drive the TTL and ECL outputs. Q5 and Q6 generate the plus and minus pulses for the main output.

SECTION 5

PARTS LIST

CODE LIST OF MANUFACTURERS

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.	18780	Malaco, Inc.	Palo Alto, Calif.	72293	Hughes Aircraft Div.	Newport Beach, Calif.
00136	McGraw Electronics	Mountain View, Calif.	18781	Philips North America	Camden, N.J.	72294	Hughes Aircraft Div.	Hicksville, N.Y.
00273	Sage Electronics Corp.	Rochester, N.Y.	18782	Clorox Mfg. Co.	Danvers, N.J.	72295	Amper Electronics Co.	Hicksville, N.Y.
00334	Hemlock Co.	San Jose, Calif.	18783	Nippon Electric Co., Ltd.	Tokyo, Japan	72296	Philips North America	Hicksville, N.Y.
00335	Westair Corp.	New York, N.Y.	18784	Delta Semiconductor Inc.	Newport Beach, Calif.	72297	Philips North America	Hicksville, N.Y.
00373	Garlock Packing Co.	Camden, N.J.	18785	Thermodyne	Holts, Texas	72298	Beckman Helipot Corp.	S. Pasadena, Calif.
00536	Electronic Prod. Div.	New Bedford, Mass.	18786	Telaflex Corp.	Manassas, Va.	72299	Beckman Helipot Corp.	Hanford, Calif.
00537	Aerovox Corp.	Harrisburg, Pa.	18787	Midland Mfg. Co.	Kansas City, Mo.	72300	Beckman Helipot Corp.	Hanford, Calif.
00779	Amg, Inc.	Bozeman, N.Y.	18788	Sem-Tech	Newbury Park, Calif.	72301	Beckman Helipot Corp.	Hanford, Calif.
00781	Ancora Radio Corp.	Bozeman, N.Y.	18789	Self-Resistor Corp.	Santa Monica, Calif.	72302	Federal Screw Prod. Co.	Chicago, Ill.
00815	Northern Eng. Lab. Inc.	Burlington, Wis.	18790	Amper Components Inc.	Conshohocken, Pa.	72303	Federal Screw Prod. Co.	Chicago, Ill.
00853	Sargento Electric Co.	Marion, Illinois	18791	Connelly Distrib. Co.	Santa Monica, Calif.	72304	Federal Screw Prod. Co.	Chicago, Ill.
00864	Orill, Div. (Cap)	Los Angeles, Calif.	18792	Williams Mfg. Co.	San Jose, Calif.	72305	Federal Screw Prod. Co.	Chicago, Ill.
00899	Gee Engineering Co.	Los Angeles, Calif.	18793	Western Electric Co., Inc.	Brooklyn, N.Y.	72306	Federal Screw Prod. Co.	Chicago, Ill.
01021	Allen Bradley Co.	Madison, Wis.	18794	Adjustable Baking Co.	New York, N.Y.	72307	Federal Screw Prod. Co.	Chicago, Ill.
01055	Linear Industries, Inc.	Beverly Hills, Calif.	18795	Twentieth Century	Santa Clara, Calif.	72308	Federal Screw Prod. Co.	Chicago, Ill.
01281	TEW Semiconductor Inc.	Longwood, Calif.	18796	Call Spring Co.	Longwood, Calif.	72309	Federal Screw Prod. Co.	Chicago, Ill.
01295	Texas Instruments, Inc.	Dallas, Texas	18797	Thermalonics, Inc.	San Jose, Calif.	72310	Federal Screw Prod. Co.	Chicago, Ill.
01349	The Alliance Mfg. Co.	Indianapolis, Ind.	18798	Thermalonics, Inc.	San Jose, Calif.	72311	Federal Screw Prod. Co.	Chicago, Ill.
01561	Chast-Trak Corp.	Indianapolis, Ind.	18799	Thermalonics, Inc.	San Jose, Calif.	72312	Federal Screw Prod. Co.	Chicago, Ill.
01569	Pacific Relay, Inc.	Rockford, Ill.	18800	Thermalonics, Inc.	San Jose, Calif.	72313	Federal Screw Prod. Co.	Chicago, Ill.
01930	Anacost Corp.	Rockford, Ill.	18801	Thermalonics, Inc.	San Jose, Calif.	72314	Federal Screw Prod. Co.	Chicago, Ill.
02161	Puller Engineering Co.	San Jose, Calif.	18802	Thermalonics, Inc.	San Jose, Calif.	72315	Federal Screw Prod. Co.	Chicago, Ill.
02164	Ferracube Corp. Amer.	San Jose, Calif.	18803	Thermalonics, Inc.	San Jose, Calif.	72316	Federal Screw Prod. Co.	Chicago, Ill.
02786	Cole Mfg. Co.	Chicago, Ill.	18804	Thermalonics, Inc.	San Jose, Calif.	72317	Federal Screw Prod. Co.	Chicago, Ill.
02787	Amphel-Borg El. Corp.	Chicago, Ill.	18805	Thermalonics, Inc.	San Jose, Calif.	72318	Federal Screw Prod. Co.	Chicago, Ill.
02830	Radio Corp. of America	San Francisco, Calif.	18806	Thermalonics, Inc.	San Jose, Calif.	72319	Federal Screw Prod. Co.	Chicago, Ill.
02831	Semiconductor Materials Div.	San Francisco, Calif.	18807	Thermalonics, Inc.	San Jose, Calif.	72320	Federal Screw Prod. Co.	Chicago, Ill.
02771	Vacuum Company of America	Old Saybrook, Conn.	18808	Thermalonics, Inc.	San Jose, Calif.	72321	Federal Screw Prod. Co.	Chicago, Ill.
02787	Hopkins Engineering Co.	San Francisco, Calif.	18809	Thermalonics, Inc.	San Jose, Calif.	72322	Federal Screw Prod. Co.	Chicago, Ill.
03008	G. J. Semiconductor Products	Syracuse, N.Y.	18810	Thermalonics, Inc.	San Jose, Calif.	72323	Federal Screw Prod. Co.	Chicago, Ill.
03705	Apex Machine and Tool Co.	Dayton, Ohio	18811	Thermalonics, Inc.	San Jose, Calif.	72324	Federal Screw Prod. Co.	Chicago, Ill.
03707	Elmore Corp.	Elmore, Calif.	18812	Thermalonics, Inc.	San Jose, Calif.	72325	Federal Screw Prod. Co.	Chicago, Ill.
03827	Transitron Electronics	San Jose, Calif.	18813	Thermalonics, Inc.	San Jose, Calif.	72326	Federal Screw Prod. Co.	Chicago, Ill.
03858	Pyramid Bellows Co.	Marion, N.J.	18814	Thermalonics, Inc.	San Jose, Calif.	72327	Federal Screw Prod. Co.	Chicago, Ill.
03984	Alfa Marine Motors, Inc.	Los Angeles, Calif.	18815	Thermalonics, Inc.	San Jose, Calif.	72328	Federal Screw Prod. Co.	Chicago, Ill.
04039	Amov, Harp and Peggman	Longwood, Calif.	18816	Thermalonics, Inc.	San Jose, Calif.	72329	Federal Screw Prod. Co.	Chicago, Ill.
04203	Taurus Corp.	Longwood, Calif.	18817	Thermalonics, Inc.	San Jose, Calif.	72330	Federal Screw Prod. Co.	Chicago, Ill.
04262	Elmore Products Co.	New York, N.Y.	18818	Thermalonics, Inc.	San Jose, Calif.	72331	Federal Screw Prod. Co.	Chicago, Ill.
04272	H. O. D. Co.	Longwood, Calif.	18819	Thermalonics, Inc.	San Jose, Calif.	72332	Federal Screw Prod. Co.	Chicago, Ill.
04278	Elgin National Watch Co.	Burlington, Vt.	18820	Thermalonics, Inc.	San Jose, Calif.	72333	Federal Screw Prod. Co.	Chicago, Ill.
04354	Precision Paper Tube Co.	Chicago, Ill.	18821	Thermalonics, Inc.	San Jose, Calif.	72334	Federal Screw Prod. Co.	Chicago, Ill.
04404	Dynac Division of Hewlett-Packard	Palo Alto, Calif.	18822	Thermalonics, Inc.	San Jose, Calif.	72335	Federal Screw Prod. Co.	Chicago, Ill.
04451	Sylvania Electric Prod., Inc.	Mountain View, Calif.	18823	Thermalonics, Inc.	San Jose, Calif.	72336	Federal Screw Prod. Co.	Chicago, Ill.
04732	Motorola Semiconductor Div.	Phoenix, Ariz.	18824	Thermalonics, Inc.	San Jose, Calif.	72337	Federal Screw Prod. Co.	Chicago, Ill.
04733	Filtron Co./Western Div.	Culver City, Calif.	18825	Thermalonics, Inc.	San Jose, Calif.	72338	Federal Screw Prod. Co.	Chicago, Ill.
04734	Automotive Electric Co.	Norwalk, Conn.	18826	Thermalonics, Inc.	San Jose, Calif.	72339	Federal Screw Prod. Co.	Chicago, Ill.
04735	Automotive Electric Co.	Norwalk, Conn.	18827	Thermalonics, Inc.	San Jose, Calif.	72340	Federal Screw Prod. Co.	Chicago, Ill.
04736	Sequeto Wire, Cable Co.	Rebwood City, Calif.	18828	Thermalonics, Inc.	San Jose, Calif.	72341	Federal Screw Prod. Co.	Chicago, Ill.
04737	Precision Coil Spring Co.	El Monte, Calif.	18829	Thermalonics, Inc.	San Jose, Calif.	72342	Federal Screw Prod. Co.	Chicago, Ill.
04870	P.H. Mott, Illinois	Chicago, Ill.	18830	Thermalonics, Inc.	San Jose, Calif.	72343	Federal Screw Prod. Co.	Chicago, Ill.
05006	20th Century Plastics	Los Angeles, Calif.	18831	Thermalonics, Inc.	San Jose, Calif.	72344	Federal Screw Prod. Co.	Chicago, Ill.
05027	Westinghouse/Semicon. Dept.	Youngwood, Pa.	18832	Thermalonics, Inc.	San Jose, Calif.	72345	Federal Screw Prod. Co.	Chicago, Ill.
05173	Ullrich, Inc.	Longwood, Calif.	18833	Thermalonics, Inc.	San Jose, Calif.	72346	Federal Screw Prod. Co.	Chicago, Ill.
05273	Illuminant Eng. Co.	Sunnyvale, Calif.	18834	Thermalonics, Inc.	San Jose, Calif.	72347	Federal Screw Prod. Co.	Chicago, Ill.
05526	Conso Plastic	Cleveland, Ohio	18835	Thermalonics, Inc.	San Jose, Calif.	72348	Federal Screw Prod. Co.	Chicago, Ill.
0564	ICo/Electrical Spec. Co.	Rockford, Ill.	18836	Thermalonics, Inc.	San Jose, Calif.	72349	Federal Screw Prod. Co.	Chicago, Ill.
05646	Borcher Cable Co.	Rockford, Ill.	18837	Thermalonics, Inc.	San Jose, Calif.	72350	Federal Screw Prod. Co.	Chicago, Ill.
05728	Tiffin Optical Co.	Rockford, Ill.	18838	Thermalonics, Inc.	San Jose, Calif.	72351	Federal Screw Prod. Co.	Chicago, Ill.
05729	Marquon Telecom. Corp.	Brooklyn, N.Y.	18839	Thermalonics, Inc.	San Jose, Calif.	72352	Federal Screw Prod. Co.	Chicago, Ill.
05737	Metra Corp.	San Jose, Calif.	18840	Thermalonics, Inc.	San Jose, Calif.	72353	Federal Screw Prod. Co.	Chicago, Ill.
05780	Stewart Engineering Co.	Wheatfield, Mass.	18841	Thermalonics, Inc.	San Jose, Calif.	72354	Federal Screw Prod. Co.	Chicago, Ill.
05823	Wheatfield Engineering Inc.	Wheatfield, Mass.	18842	Thermalonics, Inc.	San Jose, Calif.	72355	Federal Screw Prod. Co.	Chicago, Ill.
06004	The Basic Co.	Brooklyn, N.Y.	18843	Thermalonics, Inc.	San Jose, Calif.	72356	Federal Screw Prod. Co.	Chicago, Ill.
06105	Bowch and Lomb Optical	Rochester, N.Y.	18844	Thermalonics, Inc.	San Jose, Calif.	72357	Federal Screw Prod. Co.	Chicago, Ill.
06125	E.T.A. Products/Amer.	Chicago, Ill.	18845	Thermalonics, Inc.	San Jose, Calif.	72358	Federal Screw Prod. Co.	Chicago, Ill.
06475	Wester Industries, Inc.	Longwood, Calif.	18846	Thermalonics, Inc.	San Jose, Calif.	72359	Federal Screw Prod. Co.	Chicago, Ill.
06550	Anator Elect. Hardware Co.	Newark, N.J.	18847	Thermalonics, Inc.	San Jose, Calif.	72360	Federal Screw Prod. Co.	Chicago, Ill.
06555	Breda Electrical Int. Co.	Phoenix, Ariz.	18848	Thermalonics, Inc.	San Jose, Calif.	72361	Federal Screw Prod. Co.	Chicago, Ill.
06791	U.S. Sensor Div.	Phoenix, Ariz.	18849	Thermalonics, Inc.	San Jose, Calif.	72362	Federal Screw Prod. Co.	Chicago, Ill.
06882	Torrington Mfg. Co. West Div.	Van Nuys, Calif.	18850	Thermalonics, Inc.	San Jose, Calif.	72363	Federal Screw Prod. Co.	Chicago, Ill.
06883	Kelvin Electric Co.	Van Nuys, Calif.	18851	Thermalonics, Inc.	San Jose, Calif.	72364	Federal Screw Prod. Co.	Chicago, Ill.
07115	Canning Glass Works	Brooklyn, N.Y.	18852	Thermalonics, Inc.	San Jose, Calif.	72365	Federal Screw Prod. Co.	Chicago, Ill.
07126	Electronics Corp. Dept.	Brooklyn, N.Y.	18853	Thermalonics, Inc.	San Jose, Calif.	72366	Federal Screw Prod. Co.	Chicago, Ill.
07138	Transistor Electronics Corp.	Brooklyn, N.Y.	18854	Thermalonics, Inc.	San Jose, Calif.	72367	Federal Screw Prod. Co.	Chicago, Ill.
07139	Westinghouse Electric Corp.	Brooklyn, N.Y.	18855	Thermalonics, Inc.	San Jose, Calif.	72368	Federal Screw Prod. Co.	Chicago, Ill.
07140	Electronic Tube Div.	Brooklyn, N.Y.	18856	Thermalonics, Inc.	San Jose, Calif.	72369	Federal Screw Prod. Co.	Chicago, Ill.
07141	Filtron Corp.	Brooklyn, N.Y.	18857	Thermalonics, Inc.	San Jose, Calif.	72370	Federal Screw Prod. Co.	Chicago, Ill.
07142	Cinch-Graphix Co.	Brooklyn, N.Y.	18858	Thermalonics, Inc.	San Jose, Calif.	72371	Federal Screw Prod. Co.	Chicago, Ill.
07261	Annet Corp.	Brooklyn, N.Y.	18859	Thermalonics, Inc.	San Jose, Calif.	72372	Federal Screw Prod. Co.	Chicago, Ill.
07262	Fairchild Semiconductor Corp.	Mountain View, Calif.	18860	Thermalonics, Inc.	San Jose, Calif.	72373	Federal Screw Prod. Co.	Chicago, Ill.
07273	Minnesota Rubber Corp.	Minneapolis, Minn.	18861	Thermalonics, Inc.	San Jose, Calif.	72374	Federal Screw Prod. Co.	Chicago, Ill.
07287	The Briscoe Corp.	Los Angeles, Calif.	18862	Thermalonics, Inc.	San Jose, Calif.	72375	Federal Screw Prod. Co.	Chicago, Ill.
07700	Technical Wire Products	Springfield, N.J.	18863	Thermalonics, Inc.	San Jose, Calif.	72376	Federal Screw Prod. Co.	Chicago, Ill.
07701	Continental Device Corp.	Hawthorne, Calif.	18864	Thermalonics, Inc.	San Jose, Calif.	72377	Federal Screw Prod. Co.	Chicago, Ill.
07731	Breen Semiconductor Corp.	Mountain View, Calif.	18865	Thermalonics, Inc.	San Jose, Calif.	72378	Federal Screw Prod. Co.	Chicago, Ill.
07764	Shuckley Semi-Conductor Labs.	Palo Alto, Calif.	18866	Thermalonics, Inc.	San Jose, Calif.	72379	Federal Screw Prod. Co.	Chicago, Ill.
07807	Booster Radio Corp.	Bozeman, N.Y.	18867	Thermalonics, Inc.	San Jose, Calif.	72380	Federal Screw Prod. Co.	Chicago, Ill.
08145	U.S. Engineering Co.	Los Angeles, Calif.	18868	Thermalonics, Inc.	San Jose, Calif.	72381	Federal Screw Prod. Co.	Chicago, Ill.
08289	Blinn, Dabney Co.	Pomona, Calif.	18869	Thermalonics, Inc.	San Jose, Calif.	72382	Federal Screw Prod. Co.	Chicago, Ill.
08329	Burgess Battery Co.	Niagara Falls, Ontario	18870	Thermalonics, Inc.	San Jose, Calif.	72383	Federal Screw Prod. Co.	Chicago, Ill.
08717	Shan Controls, Inc.	Waterbury, Conn.	18871	Thermalonics, Inc.	San Jose, Calif.	72384	Federal Screw Prod. Co.	Chicago, Ill.
08782	Cannon Elect. Co. Phoenix Div.	Phoenix, Ariz.	18872	Thermalonics, Inc.	San Jose, Calif.	72385	Federal Screw Prod. Co.	Chicago, Ill.
08798	CBS Elect. Co.	Lowell, Mass.	18873	Thermalonics, Inc.	San Jose, Calif.	72386	Federal Screw Prod. Co.	Chicago, Ill.
08821	Oper. Div. C.B.S., Inc.	Lowell, Mass.	18874	Thermalonics, Inc.	San Jose, Calif.	72387	Federal Screw Prod. Co.	Chicago, Ill.
08924	Mail-Bair	Indianapolis, Ind.	18875	Thermalonics, Inc.	San Jose, Calif.	72388	Federal Screw Prod. Co.	Chicago, Ill.
08966	Boback Relay, Inc.	Costa Mesa, Calif.	18876	Thermalonics, Inc.	San Jose, Calif.	72389	Federal Screw Prod. Co.	Chicago, Ill.
09124	Texas Capacitor Co.	Houston, Texas	18877	Thermalonics, Inc.	San Jose, Calif.	72390	Federal Screw Prod. Co.	Chicago, Ill.
09145	Adair Electronics	San Valley, Calif.	18878	Thermalonics, Inc.	San Jose, Calif.	72391	Federal Screw Prod. Co.	Chicago, Ill.
09155	Electro Assembly, Inc.	Chicago, Ill.	18879	Thermalonics, Inc.	San Jose, Calif.	72392	Federal Screw Prod. Co.	Chicago, Ill.
09569	Mallory Battery Co./Canada Ltd.	Toronto, Ontario, Canada	18880	Thermalonics, Inc.	San Jose, Calif.	72393	Federal Screw Prod. Co.	Chicago, Ill.
10044	The Bristol Company	Los Angeles, Calif.	18881	Thermalonics, Inc.	San Jose, Calif.	72394	Federal Screw Prod. Co.	Chicago, Ill.
10214	Gen. Trans. Western Corp.	Los Angeles, Calif.	18882	Thermalonics, Inc.	San Jose, Calif.	72395	Federal Screw Prod. Co.	Chicago, Ill.
10247	Ti-Tal, Inc.	Rocky Hill, Conn.	18883	Thermalonics, Inc.	San Jose, Calif.	72396	Federal Screw Prod. Co.	Chicago, Ill.
10346	East Electronics, Inc.	Niagara Falls, N.Y.	18884	Thermalonics, Inc.	San Jose, Calif.	72397	Federal Screw Prod. Co.	Chicago, Ill.
10347	Corbunor Co.	Niagara Falls, N.Y.	18885	Thermalonics, Inc.	San Jose, Calif.	72398	Federal Screw Prod. Co.	Chicago, Ill.
11236	CTS of Borne, Inc.	Borne, Ind.	18886	Thermalonics, Inc.	San Jose, Calif.	72399	Federal Screw Prod. Co.	Chicago, Ill.
11237	Chicago of Calif., Inc.	Chicago, Ill.	18887	Thermalonics, Inc.	San Jose, Calif.	72400	Federal Screw Prod. Co.	Chicago, Ill.
11301	Microvare Inc. Corp.	Palo Alto, Calif.	18888	Thermalonics, Inc.	San Jose, Calif.	72401	Federal Screw Prod. Co.	Chicago, Ill.
11371	Duncan Electronics, Inc.	Santa Ana, Calif.	18889	Thermalonics, Inc.	San Jose, Calif.	72402	Federal Screw Prod. Co.	Chicago, Ill.
1171	Gen'l Ins./Semiconductor Div.	Buena Vista, Calif.	18890	Thermalonics, Inc.	San Jose, Calif.	72403	Federal Screw Prod. Co.	Chicago, Ill.
1534	Imperial Electronic, Inc.	Buena Vista, Calif.	18891	Thermalonics, Inc.	San Jose, Calif.	72404	Federal Screw Prod. Co.	Chicago, Ill.

PART	DESCRIPTION	EXACT NO	MFC
A0 X0001	INSTRUCTION MANUAL	100514	10597
A0 X0002	TRANSFORMER	1200039	10597
A0 X0003	THRU		
A0 X0009	BNC	1310047	10597
A0 X0010	FUSE HOLDER	1360103	10597
A0 X0011	STRAIN RELIEF	1740007	10597
A0 X0012	THRU		
A0 X0013	BNC INSULATOR	1740031	10597
A0 X0014	POWER CORD	1750203	10597
A0 X0015	THERMAL LINK TO-92	2000065	10597
A0 X0016	THRU		
A0 X0017	HEAT SINK TO-39	2000067	10597
A0 X0018	THRU		
A0 X0019	HEAT SINK TO-92	2000123	10597
A0 X0020	SWITCH CHASSIS	2592200	10597
A0 X0021	SPACER	3580072	10597
A0 X0022	THRU		
A0 X0023	KNOB, MULT, OUTER	3660134	10597
A0 X0024	THRU		
A0 X0025	KNOB, MULT, INNER	3660135	10597
A0 X0026	THRU		
A0 X0029	KNOB, SMALL, 1/8" SHAFT	3660102	10597
A0 X0030	KNOB, LARGE, 2 BAR, CON	3660104	10597
A0 X0031	KNOB, LARGE, 1/4W SHAFT	3660108	10597
A0 X0032	KNOB, LARGE, 1/8W SHAFT	3660528	10597
A0 X0033	PANEL, REAR	3890475	10597
A0 X0034	PANEL, FRONT	3890474	10597
A0 X0035	THRU		
A0 X0036	BRACKET, PCB	4060220	10597
A0 X0037	CASE	4380501	10597
A0 X0038	PCB, MAIN	4420321	10597
A0 X0039	PCB, PULSE	4420308	10597
A0 D0001	LED	1520002	10597
A0 R0001	POTENTIOMETER, 250 OHM	2600399	10597
A0 R0002	RESISTOR, SEL		
A0 R0003	THRU		
A0 R0014	RESISTOR, 100 OHM 1/8W 1%	3181000	77902
A0 R0015	UNASSIGNED		
A0 R0016	UNASSIGNED		
A0 R0017	POTENTIOMETER, 1K	3110108	10597
A0 R0018	POTENTIOMETER, 10K	3110038	10597
A0 R0019			
A0 R0029	UNASSIGNED		
A0 R0030	POTENTIOMETER, DELAY, VARIABLE	2600433	10597
A0 R0031	POTENTIOMETER, WIDTH, VARIABLE	2600434	10597
A0 R0301	POTENTIOMETER, 500 OHM	2590905	10597

PART	DESCRIPTION	EXACT NO	MFC
A0 S0001	SWITCH, POWER	2600375	10597
A0 S0002	SWITCH, MULTIPLIER	2600313	10597
A0 S0003	SWITCH, SYMMETRY	3110387	10597
A0 S0004	SWITCH, RANGE	2600515	10597
A0 S0005	SWITCH, FUNCTION	2600510	10597
A0 S0006	SWITCH, OFFSET	3110038	10597
A0 S0007	UNASSIGNED		
A0 S0008	SWITCH, DELAY	2600433	10597
A0 S0009	SWITCH, WIDTH	2600434	10597
A0 S0010	SWITCH, RAMP MODE	2600384	10597
A0 S0301	SWITCH, RUN	2600510	10597
A0 T0001	TRANSFORMER	1200036	10597
A1	MAIN PCB		
A1 C0001	THRU		
A1 C0002	CAPACITOR, 2200 μ F 35V	2900076	74840
A1 C0003	THRU		
A1 C0004	UNASSIGNED		
A1 C0005	CAPACITOR, 470 pF 50V	2810539	853
A1 C0006	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0007	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0008	THRU		
A1 C0009	UNASSIGNED		
A1 C0010	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0011	CAPACITOR, 10 pF 50V	2810529	853
A1 C0012	CAPACITOR, SEL		
A1 C0013	CAPACITOR, SEL		
A1 C0014	CAPACITOR, SEL		
A1 C0015	CAPACITOR, SET	2950014	10597
A1 C0016	CAPACITOR, 18 pF 50V	2810552	853
A1 C0017	CAPACITOR, 150 pF 50V	2810557	853
A1 C0018	CAPACITOR, 8-50 pF 50V	2810022	90201
A1 C0019	UNASSIGNED		
A1 C0020	CAPACITOR, 47 pF 50V	2810532	853
A1 C0021	CAPACITOR, 2 pF 50V	2810542	853
A1 C0022	CAPACITOR, 82 pF 50V	2810533	853
A1 C0023	CAPACITOR, 2 pF 50V	2810542	853
A1 C0024	CAPACITOR, 2 pF 50V	2810542	853
A1 C0025	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0026	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0027	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0028	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0029	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0030	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0031	CAPACITOR, 8-50 pF 50V	2810022	90201
A1 C0032	CAPACITOR, 100 μ F 50V	2900051	10597
A1 C0033	THRU		
A1 C0034	UNASSIGNED		

PART	DESCRIPTION	EXACT NO	MFC
A1 C0035	CAPACITOR, SEL		
A1 C0036	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0037	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0038	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0039	CAPACITOR, 5.5-18		
A1 C0040	CAPACITOR, SEL		
A1 C0041	CAPACITOR, 5 pF 50V	2810501	853
A1 C0042	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0043	CAPACITOR, 180 pF 50V	2810554	853
A1 C0044	UNASSIGNED		
A1 C0045	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0046	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0047	CAPACITOR, 3012 pF	2810036	90201
A1 C0048	CAPACITOR, SEL		
A1 C0049	CAPACITOR, SEL		
A1 C0050	CAPACITOR, 47 pF 50V	2810532	853
A1 C0051	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0052	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0053	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0301	CAPACITOR, .001 μ F 50V	2830000	91418
A1 C0302	CAPACITOR, 10 pF 50V	2810529	853
A1 C0303	CAPACITOR, 6.8 μ F 35V	2900073	74840
A1 C0304	CAPACITOR, 100 pF 50V	2810537	853
A1 C0305	CAPACITOR, 6.8 μ F 35V	2900073	91418
A1 C0306	CAPACITOR, 30 pF 50V	2810553	853
A1 C0307	CAPACITOR, 30 pF 50V	2810553	853
A1 D0001	THRU		
A1 D0004	DIODE, 1N4001	1524001	7263
A1 D0005	UNASSIGNED		
A1 D0006	DIODE, 1N695	1520695	7263
A1 D0007	DIODE, 1N914	1520914	7263
A1 D0008	THRU		
A1 D0010	UNASSIGNED		
A1 D0011	THRU		
A1 D0018	DIODE, 1N914	1520914	7263
A1 D0019	THRU		
A1 D0023	UNASSIGNED		
A1 D0024	THRU		
A1 D0026	DIODE, SET	1530914	10597
A1 D0027	THRU		
A1 D0033	DIODE, 1N914	1520914	7263
A1 D0301	DIODE, 1N753	1520753	7263
A1 L0001	THRU		
A1 L0007	FERRITE BEAD	1140034	1121
A1 Q0001	TRANSISTOR, 2N2484	1564250	27104
A1 Q0002	UNASSIGNED		
A1 Q0003	TRANSISTOR, 2N2484	1562484	27104

PART	DESCRIPTION	EXACT NO	MFC
A1 Q0004	UNASSIGNED		
A1 Q0005	TRANSISTOR, 2N2484	1562484	27104
A1 Q0006	TRANSISTOR, 2N5485	1565485	27104
A1 Q0007	TRANSISTOR, 2N2484	1562484	27104
A1 Q0008	TRANSISTOR, 2N2484	1562484	27104
A1 Q0009	TRANSISTOR, 2N5485	1565485	27104
A1 Q0010	TRANSISTOR, 2N2484	1562484	27104
A1 Q0011	TRANSISTOR, 2N3646	1563646	27104
A1 Q0012	TRANSISTOR, SET	157087	10597
A1 Q0013	TRANSISTOR, 2N2484	1562484	27104
A1 Q0014	TRANSISTOR, 2N4121	1564121	27104
A1 Q0015	TRANSISTOR, 2N4121	1564121	27104
A1 Q0016	TRANSISTOR, 2N4121	1564121	27104
A1 Q0017	TRANSISTOR, 2N3646	1563646	27104
A1 Q0018	TRANSISTOR, 2N2219	1562219	27104
A1 Q0019	THRU		
A1 Q0022	UNASSIGNED		
A1 Q0023	TRANSISTOR, 2N4121	1564121	27104
A1 Q0024	TRANSISTOR, 2N4121	1564121	27104
A1 Q0025	TRANSISTOR, 2N4258	1564258	27104
A1 Q0026	TRANSISTOR, 2N4258	1564258	27104
A1 Q0027	TRANSISTOR, 2N4121	1564121	27104
A1 Q0028	TRANSISTOR, TIS87	1560087	12944
A1 Q0029	TRANSISTOR, TIS87	1560087	12944
A1 Q0030	TRANSISTOR, 2N4121	1564121	27104
A1 Q0031	TRANSISTOR, 2N4121	1564121	27104
A1 Q0032	TRANSISTOR, 2N4121	1564121	27104
A1 Q0033	TRANSISTOR, TIS87	1560087	12944
A1 Q0034	TRANSISTOR, TIS87	1560087	12944
A1 Q0035	TRANSISTOR, 2N4121	1564121	27104
A1 Q0036	TRANSISTOR, 2N2219	1562219	27104
A1 Q0037	TRANSISTOR, 2N2905	1562905	27104
A1 Q0301	TRANSISTOR, 2N4250	1564250	27104
A1 Q0302	TRANSISTOR, 2N4258	1564258	27104
A1 Q0303	TRANSISTOR, 2N4258	1564258	27104
A1 Q0304	TRANSISTOR, 2N3646	1563646	27104
A1 R0001	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A1 R0002	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A1 R0003	RESISTOR, 680 OHM 1/4W 5%	3070681	77902
A1 R0004	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 R0005	RESISTOR, 620 OHM 1/4W 5%	3070621	77902
A1 R0006	RESISTOR, 24.3K OHM 1/8W 1%	3182432	77902
A1 R0007	RESISTOR, 10K OHM 1/8W 1%	3181002	77902
A1 R0008	RESISTOR, 31.6K OHM 1/8W 1%	3183162	77902
A1 R0009	RESISTOR, 34.8K OHM 1/8W 1%	3183482	77902
A1 R0010	POTENTIOMETER, 10K OHM	3110150	11237
A1 R0011	RESISTOR, 1M 1/4W 5%	3070105	77902

PART	DESCRIPTION	EXACT NO	MFC
A1 R0012	RESISTOR, 1K OHM 1/4W 5%	3070102	77902
A1 R0013	RESISTOR, 3.9K OHM 1/4W 5%	3070392	77902
A1 R0014	RESISTOR, 3K OHM 1/4W 5%	3070302	77902
A1 R0015	UNASSIGNED		
A1 R0016	UNASSIGNED		
A1 R0017	UNASSIGNED		
A1 R0018	RESISTOR, 31.6K OHM 1/8W 1%	3183162	77902
A1 R0019	RESISTOR, 750 OHM 1/8W 1%	3187500	77902
A1 R0020	POTENTIOMETER, 500 OHM	3110142	11237
A1 R0021	THRU		
A1 R0022	UNASSIGNED		
A1 R0023	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0024	POTENTIOMETER, 1K OHM	3110147	11237
A1 R0025	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0026	RESISTOR, 2.7K OHM 1/4W 5%	3070272	77902
A1 R0027	RESISTOR, 2K OHM 1/4W 5%	3070202	77902
A1 R0028	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0029	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0030	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0031	RESISTOR, 953 OHM 1/8W 1%	3189530	77902
A1 R0032	POTENTIOMETER, 100 OHM	3110141	11237
A1 R0033	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0034	RESISTOR, 3.3K OHM 1/4W 5%	3070332	77902
A1 R0035	POTENTIOMETER, 10K OHM	3110150	11237
A1 R0036	RESISTOR, 470 OHM 1/4W 5%	3070471	77902
A1 R0037	RESISTOR, 1K OHM 1/4W 5%	3070102	77902
A1 R0038	RESISTOR, 680 OHM 1/2W 5%	3010681	77902
A1 R0039	RESISTOR, 270 OHM 1/4W 5%	3070271	77902
A1 R0040	POTENTIOMETER, 5K OHM	3110149	11237
A1 R0041	THRU		
A1 R0042	RESISTOR, 499 OHM 1/8W 1%	3184990	77902
A1 R0043	RESISTOR, 7.50K OHM 1/8W 1%	3187501	77902
A1 R0044	POTENTIOMETER, 5K OHM	3110149	11237
A1 R0045	RESISTOR, 150 OHM 1/4W 5%	3070151	77902
A1 R0046	RESISTOR, 2K OHM 1/4W 5%	3070202	77902
A1 R0047	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 R0048	THRU		
A1 R0049	RESISTOR, 499 OHM 1/8W 1%	3184990	77902
A1 R0050	THRU		
A1 R0051	RESISTOR, 10K OHM 1/8W 1%	3181002	77902
A1 R0052	RESISTOR, 2.21K OHM 1/8W 1%	3182211	77902
A1 R0053	RESISTOR, 665 OHM 1/8W 1%	3186650	77902
A1 R0054	RESISTOR, 15K OHM 1/8W 1%	3181502	77902
A1 R0055	RESISTOR, 3.92K OHM 1/8W 1%	3183921	77902
A1 R0056	RESISTOR, 3.92K OHM 1/8W 1%	3183921	77902
A1 R0057	RESISTOR, 402 OHM 1/8W 1%	3184020	77902
A1 R0058	RESISTOR, 680 OHM 1/2W 5%	3010681	77902

PART	DESCRIPTION					EXACT NO	MFC
A1 R0059	RESISTOR,	619	OHM	1/8W	1%	3186190	77902
A1 R0060	RESISTOR,	432	OHM	1/8W	1%	3184320	77902
A1 R0061	RESISTOR,	909	OHM	1/8W	1%	3189090	77902
A1 R0062	RESISTOR,	6.81K	OHM	1/8W	1%	3186811	77902
A1 R0063	THRU						
A1 R0064	UNASSIGNED						
A1 R0065	RESISTOR,	2K	OHM	1/4W	5%	3070202	77902
A1 R0066	RESISTOR,	820	OHM	1/4W	5%	3070821	77902
A1 R0067	RESISTOR,	47	OHM	1/4W	5%	3070470	77902
A1 R0068	RESISTOR,	1.5K	OHM	1/4W	5%	3070152	77902
A1 R0069	RESISTOR,	47	OHM	1/4W	5%	3070470	77902
A1 R0070	RESISTOR,	1.2K	OHM	1/4W	5%	3070122	77902
A1 R0071	RESISTOR,	47	OHM	1/4W	5%	3070470	77902
A1 R0072	THRU						
A1 R0074	UNASSIGNED						
A1 R0075	POTENTIOMETER,	500	OHM			3110142	11237
A1 R0076	RESISTOR,	1.91K	OHM	1/8W	1%	3181911	77902
A1 R0077	POTENTIOMETER,	1K	OHM			3110147	11237
A1 R0078	RESISTOR,	4.02K	OHM	1/8W	1%	3184021	77902
A1 R0079	RESISTOR,	442	OHM	1/8W	1%	3184420	77902
A1 R0080	RESISTOR,	470	OHM	1/4W	5%	3070471	77902
A1 R0081	RESISTOR,	1K	OHM	1/4W	5%	3070102	77902
A1 R0082	RESISTOR,	15K	OHM	1/4W	5%	3070153	77902
A1 R0083	POTENTIOMETER,	10K	OHM			3110150	11237
A1 R0084	RESISTOR,	88.7	OHM	1/8W	1%	3180887	77902
A1 R0085	RESISTOR,	100	OHM	1/8W	1%	3181000	77902
A1 R0086	POTENTIOMETER,	100	OHM			3110141	11237
A1 R0087	RESISTOR,	SEL					
A1 R0088	RESISTOR,	330	OHM	1/4W	5%	3070331	77902
A1 R0089	RESISTOR,	5.6K	OHM	1/4W	5%	3070562	77902
A1 R0090	RESISTOR,	100K	OHM	1/4W	5%	3070104	77902
A1 R0091	POTENTIOMETER,	10K	OHM			3110150	11237
A1 R0092	RESISTOR,	1K	OHM	1/8W	1%	3181001	77902
A1 R0093	RESISTOR,	10K	OHM	1/4W	5%	3070103	77902
A1 R0094	RESISTOR,	100	OHM	1/4W	5%	3070101	77902
A1 R0095	RESISTOR,	10K	OHM	1/4W	5%	3070103	77902
A1 R0096	RESISTOR,	5.6K	OHM	1/4W	5%	3070562	77902
A1 R0097	RESISTOR,	1.3K	OHM	1/4W	5%	3070132	77902
A1 R0098	RESISTOR,	100	OHM	1/4W	5%	3070101	77902
A1 R0099	RESISTOR,	1.3K	OHM	1/4W	5%	3070132	77902
A1 R0100	RESISTOR,	20	OHM	1/4W	5%	3070200	77902
A1 R0101	RESISTOR,	1K	OHM	1/8W	1%	3181001	77902
A1 R0102	RESISTOR,	1.3K	OHM	1/4W	5%	3070132	77902
A1 R0103	POTENTIOMETER,	100	OHM			3110141	11237
A1 R0104	RESISTOR,	100	OHM	1/8W	1%	3181000	77902
A1 R0105	RESISTOR,	15	OHM	1/8W	1%	3180150	77902
A1 R0106	RESISTOR,	3.9K	OHM	1/4W	5%	3070392	77902

PART	DESCRIPTION	EXACT NO	MFC
A1 R0107	POTENTIOMETER, 10K OHM	3110150	11237
A1 R0108	THRU		
A1 R0109	RESISTOR, 8.45K OHM 1/8W 1%	3188451	77902
A1 R0110	RESISTOR, 309 OHM 1/8W 1%	3183090	77902
A1 R0111	THRU		
A1 R0112	RESISTOR, 9.76K OHM 1/8W 1%	3189761	77902
A1 R0113	RESISTOR, 200 OHM 1/8W 1%	3182000	77902
A1 R0114	THRU		
A1 R0115	RESISTOR, 19.6K OHM 1/8W 1%	3181962	77902
A1 R0116	RESISTOR, 127 OHM 1/8W 1%	3181270	77902
A1 R0117	RESISTOR, 63.4 OHM 1/8W 1%	3180634	77902
A1 R0118	UNASSIGNED		
A1 R0119	UNASSIGNED		
A1 R0120	RESISTOR, 1K OHM 1/8W 1%	3181001	77902
A1 R0121	UNASSIGNED		
A1 R0122	RESISTOR, 4.53K OHM 1/8W 1%	3184531	77902
A1 R0123	RESISTOR, 1.1K OHM 1/4W 5%	3070112	77902
A1 R0124	RESISTOR, 2.2K OHM 1/4W 5%	3070222	77902
A1 R0125	RESISTOR, 360 OHM 1/4W 5%	3070361	77902
A1 R0126	RESISTOR, 3K OHM 1/4W 5%	3070302	77902
A1 R0127	RESISTOR, 3.3K OHM 1/4W 5%	3070332	77902
A1 R0128	POTENTIOMETER, 10K OHM	3110150	11237
A1 R0129	RESISTOR, 100K OHM 1/4W 5%	3070104	77902
A1 R0130	RESISTOR, 130 OHM 1/4W 5%	3070131	77902
A1 R0131	RESISTOR, 100 OHM 1/4W 5%	3070101	77902
A1 R0132	RESISTOR, 130 OHM 1/4W 5%	3070131	77902
A1 R0133	RESISTOR, 20 OHM 1/4W 5%	3070200	77902
A1 R0134	RESISTOR, 4.02K OHM 1/8W 1%	3184021	77902
A1 R0135	RESISTOR, 390 OHM 1/4W 5%	3070391	77902
A1 R0136	RESISTOR, 20 OHM 1/4W 5%	3070200	77902
A1 R0137	RESISTOR, 10 OHM 1/4W 5%	3070100	77902
A1 R0138	POTENTIOMETER, 2.5K OHM	3110148	11237
A1 R0139	RESISTOR, 10 OHM 1/4W 5%	3070100	77902
A1 R0140	THRU		
A1 R0142	RESISTOR, 150 OHM 1/2W 1%	3101500	77902
A1 R0143	RESISTOR, 499 OHM 1/4W 1%	3134990	77902
A1 R0144	RESISTOR, 54.9 OHM 1/8W 1%	3180549	77902
A1 R0301	RESISTOR, 21.5K OHM 1/8W 1%	3182152	77902
A1 R0302	POTENTIOMETER, 1K OHM	3110147	11237
A1 R0303	RESISTOR, 2.61K OHM 1/8W 1%	3182612	77902
A1 R0304	POTENTIOMETER, 1K OHM	3110147	11237
A1 R0305	RESISTOR, 100 OHM 1/4W 5%	3070101	77902
A1 R0306	RESISTOR, 499 OHM 1/8W 1%	3184990	77902
A1 R0307	RESISTOR, 21.5K OHM 1/8W 1%	3182152	77902
A1 R0308	RESISTOR, 470 OHM 1/4W 5%	3070471	77902
A1 R0309	RESISTOR, 3.01K OHM 1/8W 1%	3183011	77902
A1 R0310	RESISTOR, 1K OHM 1/4W 5%	3070102	77902

PART	DESCRIPTION	EXACT NO	MFC
A1 R0311	RESISTOR, 3K OHM 1/4W 5%	3070302	77902
A1 R0312	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A1 R0313	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A1 R0314	RESISTOR, 3K OHM 1/4W 5%	3070302	77902
A1 R0315	RESISTOR, 100K OHM 1/4W 5%	3070104	77902
A1 R0316	RESISTOR, 3K OHM 1/4W 5%	3070302	77902
A1 R0317	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 R0318	RESISTOR, 82K OHM 1/4W 5%	3070823	77902
A1 R0319	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 R0320	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 R0321	RESISTOR, 10K OHM 1/4W 5%	3070103	77902
A1 U0001	INTEGRATED CIRCUIT, MC7812CP	1587812	27104
A1 U0002	INTEGRATED CIRCUIT, MC7912CP	1587912	27104
A1 U0003	INTEGRATED CIRCUIT, μ A741CP	1580010	27104
A1 U0004	INTEGRATED CIRCUIT, CA3140	1583140	18722
A1 U0005	INTEGRATED CIRCUIT, MC7805CP	1587805	27104
A1 U0006	UNASSIGNED		
A1 U0007	INTEGRATED CIRCUIT, CA3096AE	1583096	18722
A1 U0008	INTEGRATED CIRCUIT, μ A741CP	1580010	27104
A1 U0301	INTEGRATED CIRCUIT, LM78L05	1587895	27104
A1 U0302	INTEGRATED CIRCUIT, 7400	1580011	12944
A1 U0303	INTEGRATED CIRCUIT, μ A710	1580020	12944
A2	PULSE PCB		
A2 C0001	THRU		
A2 C0003	CAPACITOR, 6.8 μ F 35V	2900043	100002
A2 C0004	UNASSIGNED		
A2 C0005	UNASSIGNED		
A2 C0006	CAPACITOR, 0.01 μ F	2830005	91418
A2 C0007	CAPACITOR, 0.01 μ F	2830005	91418
A2 C0008	CAPACITOR, 10 μ F	2810529	853
A2 C0009	CAPACITOR, 10 μ F	2900072	55112
A2 C0010	CAPACITOR, 0.001 μ F	2900071	55112
A2 C0011	CAPACITOR, 0.01 pF	2900070	55112
A2 C0012	CAPACITOR, 0.1 pF	2900069	55112
A2 C0013	CAPACITOR, 1.0 pF	2900068	55112
A2 C0014	CAPACITOR, 47 pF	2810532	853
A2 C0015	CAPACITOR, 39 pF	2810531	853
A2 C0016	CAPACITOR, 0.01 μ F	2830005	91418
A2 C0017	CAPACITOR, 0.01 μ F	2830005	91418
A2 C0018	CAPACITOR, 10 pF	2810529	853
A2 C0019	CAPACITOR, 10 μ F	2900072	55112
A2 C0020	CAPACITOR, 0.001 μ F	2900071	55112
A2 C0021	CAPACITOR, 0.01 μ F	2900070	55112
A2 C0022	CAPACITOR, 0.1 μ F	2900069	55112
A2 C0023	CAPACITOR, 1.0 μ F	2900068	55112

PART	DESCRIPTION	EXACT NO	MFC
A2 C0024	CAPACITOR, 47 pF	2810532	853
A2 C0025	CAPACITOR, 39 pF	2810531	853
A2 C0026	UNASSIGNED		
A2 C0027	UNASSIGNED		
A2 C0028	UNASSIGNED		
A2 C0029	UNASSIGNED		
A2 C0030	CAPACITOR, 5000 pF	2830011	91418
A2 C0031	CAPACITOR, 1 μ F 35V	2900046	56289
A2 C0032	UNASSIGNED		
A2 C0033	CAPACITOR, 0.1 μ F	2830002	56289
A2 C0034	THRU		
A2 C0037	UNASSIGNED		
A2 C0038	CAPACITOR, 1 μ F 50V	2830002	91418
A2 C0039	CAPACITOR, 1 μ F 50V	2830002	91418
A2 C0040	CAPACITOR, 68 pF	2810523	853
A2 C0041	UNASSIGNED		
A2 C0042	CAPACITOR, 100 pF	2810537	853
A2 C0043	UNASSIGNED		
A2 C0044	CAPACITOR, 68 pF	2810523	853
A2 C0045	CAPACITOR, 68 pF	2810523	853
A2 C0046	UNASSIGNED		
A2 C0047	UNASSIGNED		
A2 C0048	CAPACITOR, 220 pF	2810555	853
A2 C0049	CAPACITOR, .05 μ F	2830010	91418
A2 D0001	DIODE, 1N914	1520914	7910
A2 D0002	DIODE, 1N914	1520914	7910
A2 D0003	DIODE, 1N751A	1520751	75042
A2 D0004	DIODE, 1N751A	1520751	75042
A2 L0001	THRU		
A2 L0004	UNASSIGNED		
A2 L0005	CHOKE 2 TURN BEAD	1140029	10597
A2 Q0001	THRU		
A2 Q0005	UNASSIGNED		
A2 Q0006	TRANSISTOR, 2N4258	1564258	7263
A2 Q0007	TRANSISTOR, 2N3563	1563563	27104
A2 Q0008	TRANSISTOR, 2N3563	1563563	27104
A2 Q0009	TRANSISTOR, 2N3646	1563646	27104
A2 Q0010	TRANSISTOR, 2N3646	1563646	27104
A2 R0001	RESISTOR, 100 OHM 1/2W 5%	3050101	1121
A2 R0002	RESISTOR, 680 OHM 1/4W 5%	3070681	1121
A2 R0003	RESISTOR, 100 OHM 1/4W 5%	3070101	1121
A2 R0004	RESISTOR, 680 OHM 1/4W 5%	3070681	1121
A2 R0005	RESISTOR, 1000 OHM 1/4W 5%	3070102	1121
A2 R0006	RESISTOR, 680 OHM 1/4W 5%	3070681	1121
A2 R0007	RESISTOR, 3000 OHM 1/4W 5%	3070302	1121
A2 R0008	UNASSIGNED		
A2 R0009	RESISTOR, 680 OHM 1/4W 5%	3070681	1121

PART	DESCRIPTION					EXACT NO	MFC
A2 R0010	RESISTOR,	100	OHM	1/4W	5%	3070101	1121
A2 R0011	RESISTOR,	680	OHM	1/4W	5%	3070681	1121
A2 R0012	UNASSIGNED						
A2 R0013	RESISTOR,	1000	OHM	1/4W	5%	3070102	1121
A2 R0014	RESISTOR,	680	OHM	1/4W	5%	3070681	1121
A2 R0015	RESISTOR,	3000	OHM	1/4W	5%	3070302	1121
A2 R0016	THRU						
A2 R0023	UNASSIGNED						
A2 R0024	THRU						
A2 R0026	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0027	RESISTOR,	680	OHM	1/4W	5%	3070681	1121
A2 R0028	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0029	RESISTOR,	680	OHM	1/4W	5%	3070681	1121
A2 R0030	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0031	RESISTOR,	560	OHM	1/2W	5%	3010561	1121
A2 R0032	RESISTOR,	120	OHM	1/4W	5%	3070121	1121
A2 R0033	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0034	RESISTOR,	120	OHM	1/4W	5%	3070121	1121
A2 R0035	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0036	RESISTOR,	680	OHM	1/4W	5%	3070681	1121
A2 R0037	RESISTOR,	10	OHM	1/4W	5%	3070100	1121
A2 R0038	UNASSIGNED						
A2 R0039	RESISTOR,	1.69K	OHM	1/8W	1%	3181691	77902
A2 R0040	POTENTIOMETER,	500	OHM			3110346	11237
A2 R0041	JUMPER						
A2 R0042	RESISTOR,	374	OHM	1/8W	1%	3183740	77902
A2 R0043	RESISTOR,	10	OHM	1/4W	5%	3070100	77902
A2 R0044	RESISTOR,	680	OHM	1/4W	5%	3070681	77902
A2 R0045	RESISTOR,	249	OHM	1/8W	1%	3182490	77902
A2 R0046	RESISTOR,	2.74K	OHM	1/8W	1%	3182741	77902
A2 R0047	UNASSIGNED						
A2 R0048	UNASSIGNED						
A2 R0049	POTENTIOMETER,	10K	OHM			3110349	11237
A2 R0050	THRU						
A2 R0054	UNASSIGNED						
A2 R0055	RESISTOR,	2K	OHM	1/8W	1%	3182001	77902
A2 R0056	RESISTOR,	4.02K	OHM	1/8W	1%	3184021	77902
A2 R0057	RESISTOR,	6.19K	OHM	1/8W	1%	3186191	77902
A2 R0058	RESISTOR,	63.4K	OHM	1/8W	1%	3186342	77902
A2 R0059	RESISTOR,	2K	OHM	1/8W	1%	3182001	77902
A2 R0060	RESISTOR,	4.02K	OHM	1/8W	1%	3184021	77902
A2 R0061	RESISTOR,	6.19K	OHM	1/8W	1%	3186191	77902
A2 R0062	RESISTOR,	63.4K	OHM	1/8W	1%	3186342	77902
A2 R0063	RESISTOR,	1.8K	OHM	1/4W	5%	3070182	77902
A2 R0064	RESISTOR,	200	OHM	1/4W	5%	3070201	77902
A2 R0065	RESISTOR,	200	OHM	1/4W	5%	3070201	77902
A2 R0066	RESISTOR,	47	OHM	1/4W	5%	3070470	77902
A2 R0067	RESISTOR,	47	OHM	1/4W	5%	3070470	77902

PART	DESCRIPTION	EXACT NO	MFC
A2 R0068	RESISTOR, 100 OHM 1/4W 5%	3070101	77902
A2 R0069	RESISTOR, 680 OHM 1/2W 5%	3070681	77902
A2 R0070	UNASSIGNED		
A2 R0071	RESISTOR, 270 OHM 1/4W 5%	3070271	77902
A2 R0072	RESISTOR, 270 OHM 1/4W 5%	3070271	77902
A2 R0073	RESISTOR, 470 OHM 1/4W 5%	3070471	77902
A2 R0074	RESISTOR, 470 OHM 1/4W 5%	3070471	77902
A2 R0075	RESISTOR, 680 OHM 1/4W 5%	3070681	77902
A2 R0076	RESISTOR, 2.2K OHM 1/4W 5%	3070222	77902
A2 R0077	RESISTOR, 2.2K OHM 1/4W 5%	3070222	77902
A2 R0078	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A2 R0079	RESISTOR, 4.7K OHM 1/4W 5%	3070472	77902
A2 R0080	RESISTOR, 680 OHM 1/4W 5%	3070681	77902
A2 R0081	RESISTOR, 750 OHM 1/8W 1%	3187500	77902
A2 R0082	POTENTIOMETER, 500 OHM	3110346	11237
A2 R0083	RESISTOR, 39K OHM 1/4W 5%	3070393	77902
A2 R0084	POTENTIOMETER, 500 OHM	3110346	11237
A2 R0085	RESISTOR, 100 OHM 1/4W 5%	3070101	77902
A2 R0086	RESISTOR, 100 OHM 1/4W 5%	3070101	77902
A2 R0087	RESISTOR, 63.4K OHM 1/8W 1%	3186342	77902
A2 U0001	UNASSIGNED		
A2 U0002	THRU		
A2 U0004	INTEGRATED CIRCUIT, MC10105P	1580105	4713
A2 U0005	UNASSIGNED		
A2 U0006	INTEGRATED CIRCUIT, SN745140	1580140	1295
A2 U0007	INTEGRATED CIRCUIT, CA4136	1584136	18722
A2 U0008	INTEGRATED CIRCUIT, MC10105	1580105	4713

514A ADDITIONS:

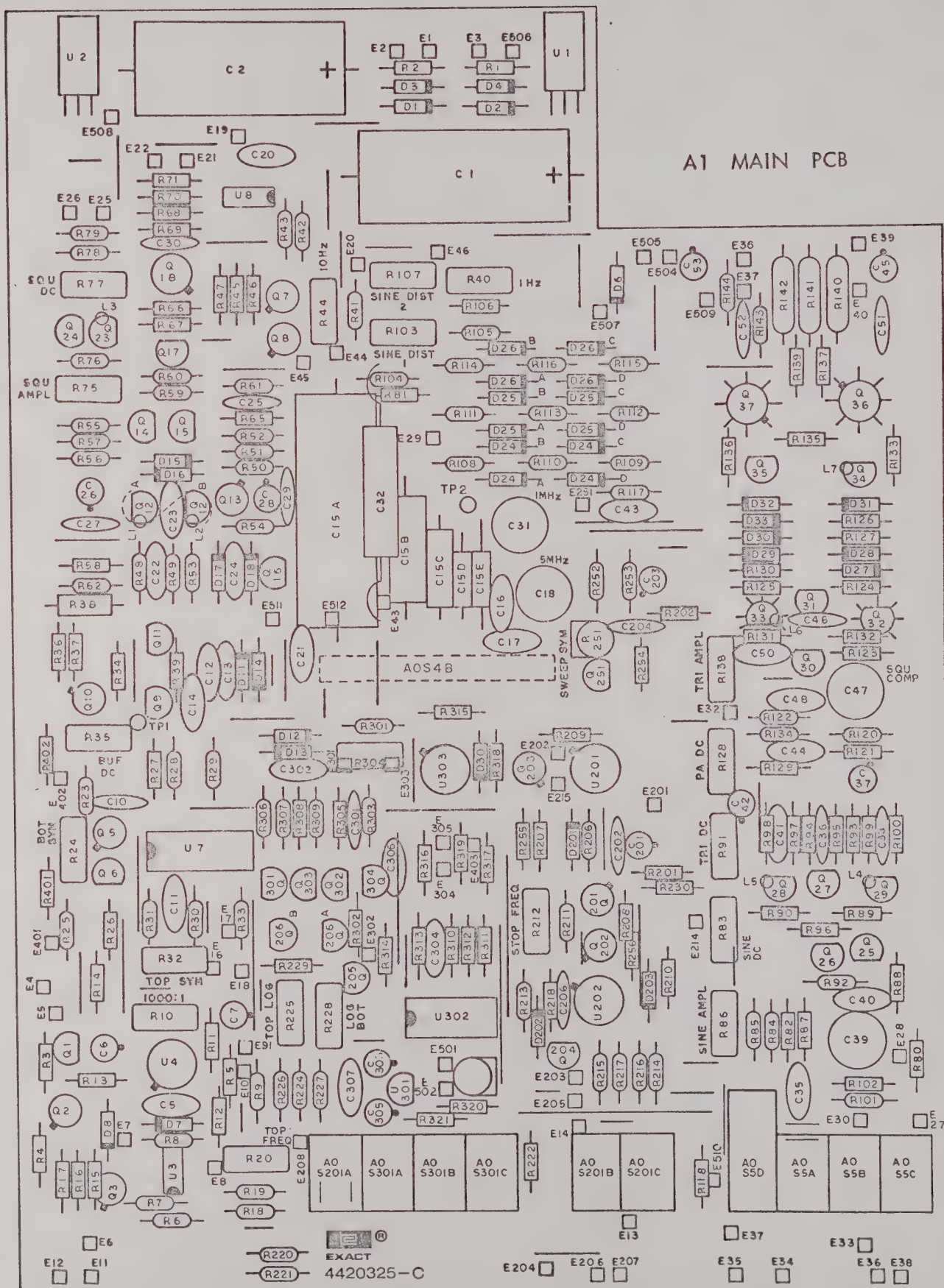
A0	CHASSIS		
A0 X0001	KNOB, SMALL, 1/8W SHAFT	3660102	10597
A0 X0002	KNOB, LARGE, 2 BAR, CON	3660104	10597
A0 X0003	BNC CONNECTOR	1310047	10597
A0 X0004	BNC CONNECTOR	1310047	10597
A0 X0005	PANEL, FRONT	3890468	10597
A0 X0006	PCB, ATTN	4420253	10597
A0 R0016	POTENTIOMETER, 20K OHM	3110387	10597
A0 R0301	POTENTIOMETER, 500 OHM	2590905	10597
A0 S0003	SWITCH, SYMMETRY	3110387	10597
A0 S0007	SWITCH, ATTN	2600349	10597
A1	MAIN PCB		
A1 R0118	RESISTOR, 10 OHM 1/4W 5%	3070100	10597
A1 R0301	RESISTOR, 2K OHM 1/8W 1%	3182001	77902
A1 R0302	RESISTOR, 2.4K OHM 1/4W 5%	3070242	77902
A1 R0303	RESISTOR, 47 OHM 1/4W 5%	3070470	77902

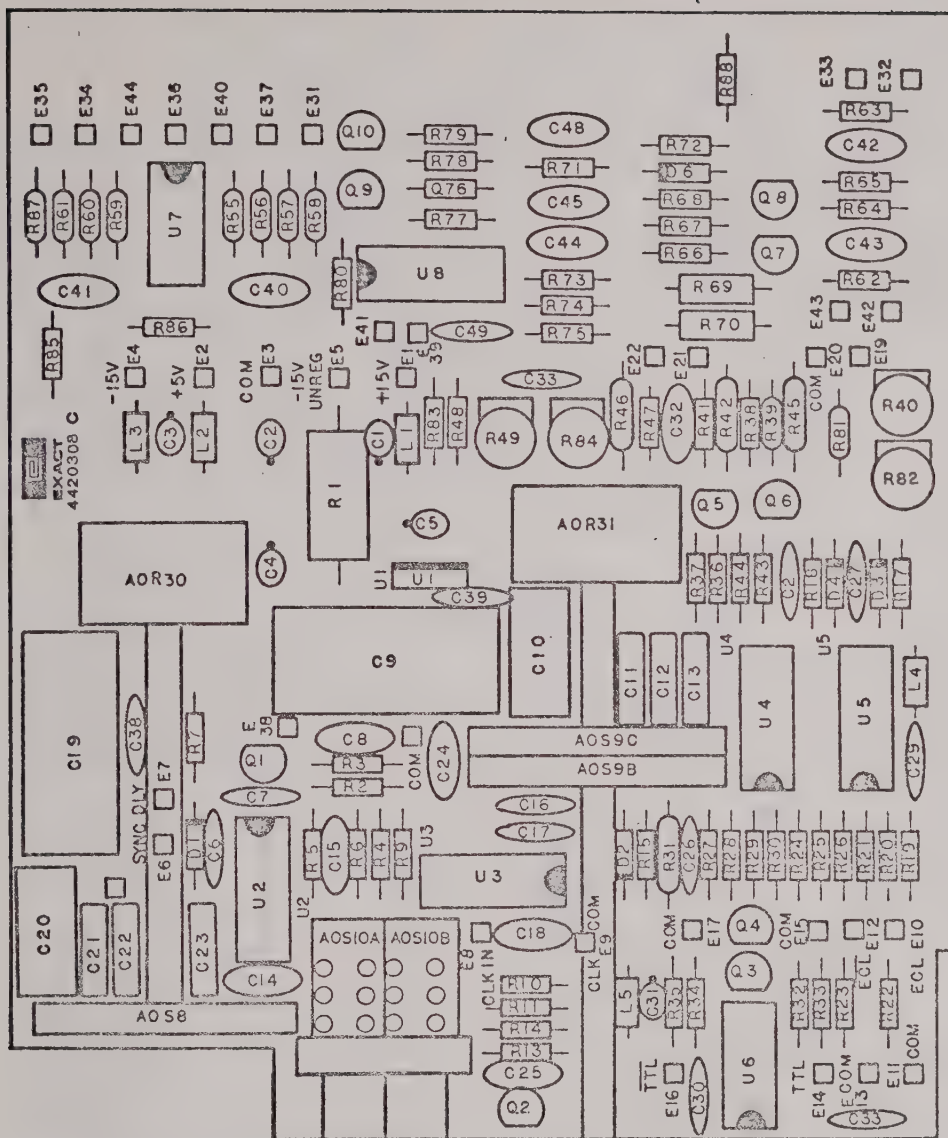
PART	DESCRIPTION	EXACT NO	MFC
514A ADDITIONS: (cont.)			
A2	PULSE PCB		
A2 C0003	THRU		
A2 C0004	CAPACITOR, 6.8	2900073	74840
A2 C0027	CAPACITOR, .005	2830011	91418
A2 C0028	CAPACITOR, .005	2830011	91418
A2 C0029	CAPACITOR, .01	2830005	91418
A2 D0003	THRU		
A2 D0004	DIODE, 1N751	1520751	7263
A2 L0004	CHOKE, 3 TURN BEAD	1140030	10597
A2 R0001	RESISTOR, 100 OHM 2W 5%	3050101	1121
A2 R0017	RESISTOR, 470 OHM 1/4W 5%	3070471	1121
A2 R0018	RESISTOR, 470 OHM 1/4W 5%	3070471	1121
A2 R0019	THRU		
A2 R0021	RESISTOR, 10 OHM 1/4W 5%	3070100	1121
A2 R0022	RESISTOR, 270 OHM 1/4W 5%	3070271	1121
A2 R0023	RESISTOR, 270 OHM 1/4W 5%	3070271	1121
A2 U0001	INTEGRATED CIRCUIT, 7905	1587905	27104
A2 U0005	INTEGRATED CIRCUIT, 10110	1580110	4713
A3	ATTENUATOR		
A3 R0019	RESISTOR, 26.1 OHM 1/8W 1%	3180261	77902
A3 R0020	RESISTOR, 38.4 OHM 1/8W 1%	3180384	77902
A3 R0021	RESISTOR, 26.1 OHM 1/8W 1%	3180261	77902
A3 R0022	RESISTOR, 41.2 OHM 1/2W 1%	3110412	77902
A3 R0023	RESISTOR, 10.0 OHM 1/8W 1%	3180100	77902
A3 R0024	RESISTOR, 41.2 OHM 1/2W 1%	3100412	77902
A3 R0025	RESISTOR, 46.4 OHM 1/2W 1%	3100464	77902
A3 R0026	RESISTOR, 3.16 OHM 1/8W 1%		77902
A3 R0027	RESISTOR, 46.4 OHM 1/2W 1%	3100464	77902
514A DELETIONS:			
A0 X0001	KNOB, LARGE, 2 BAR	3660103	10597
A0 X0002	PANEL, FRONT	3660474	10597
A1 C0301	CAPACITOR, .001 μ F 50V	2830000	91418
A1 R0301	RESISTOR, 21.5K OHM 1/8W 1%	3182152	77902
A1 R0303	RESISTOR, 2.61K OHM 1/8W 1%	3182611	77902
A1 R0304	POTENTIOMETER, 1K OHM	3110147	11237
A1 R0305	RESISTOR, 100 OHM 1/4W 5%	3070101	
A1 R0143	RESISTOR, 499 OHM		
A1 R0144	RESISTOR, 54.9 OHM		

PART	DESCRIPTION	EXACT NO	MFC
514 OPTION K			
A1 R0140	RESISTOR, 590 OHM 1/8W 1%	3185900	77902
A1 R0141	DELETE		
A1 R0142	DELETE		
A1 R0143	RESISTOR, 6.04K OHM 1/8W 1%	3186041	77902
A1 R0144	RESISTOR, 665 OHM 1/8W 1%	3186650	77902
A3 R0019	RESISTOR, 309 OHM 1/8W 1%	3183090	77902
A3 R0020	RESISTOR, 422 OHM 1/8W 1%	3184220	77902
A3 R0021	RESISTOR, 309 OHM 1/8W 1%	3183090	77902
A3 R0022	RESISTOR, 487 OHM 1/8W 1%	3184870	77902
A3 R0023	RESISTOR, 121 OHM 1/8W 1%	3181210	77902
A3 R0024	RESISTOR, 487 OHM 1/8W 1%	3184870	77902
A3 R0025	RESISTOR, 562 OHM 1/8W 1%	3185620	77902
A3 R0026	RESISTOR, 38.3 OHM 1/8W 1%	3180383	77902
A3 R0027	RESISTOR, 562 OHM 1/8W 1%	3185620	77902

SECTION 6

SCHEMATICS



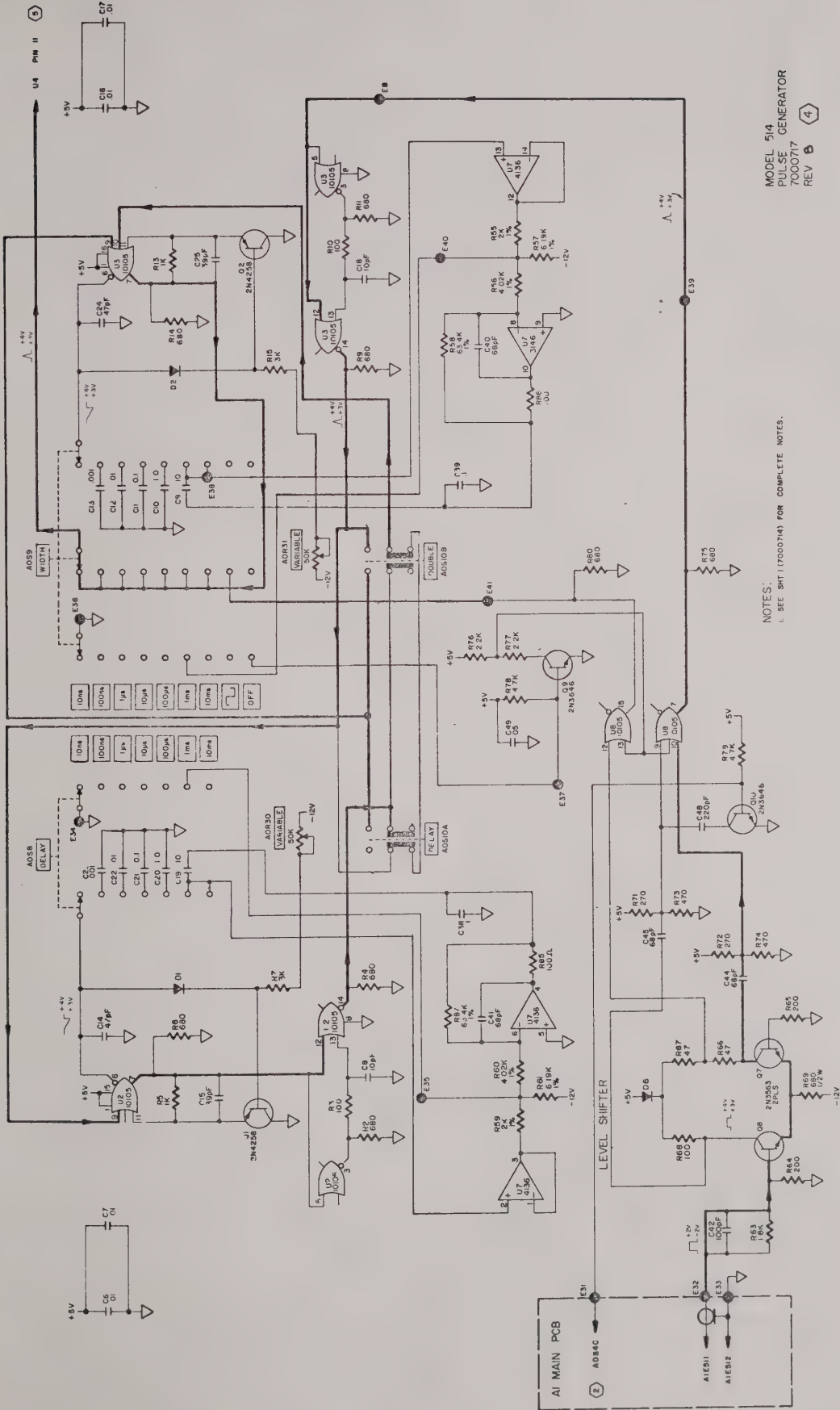




NOTES:
1. SEE SHEET (1700-3714) FOR COMPLETE NOTES.

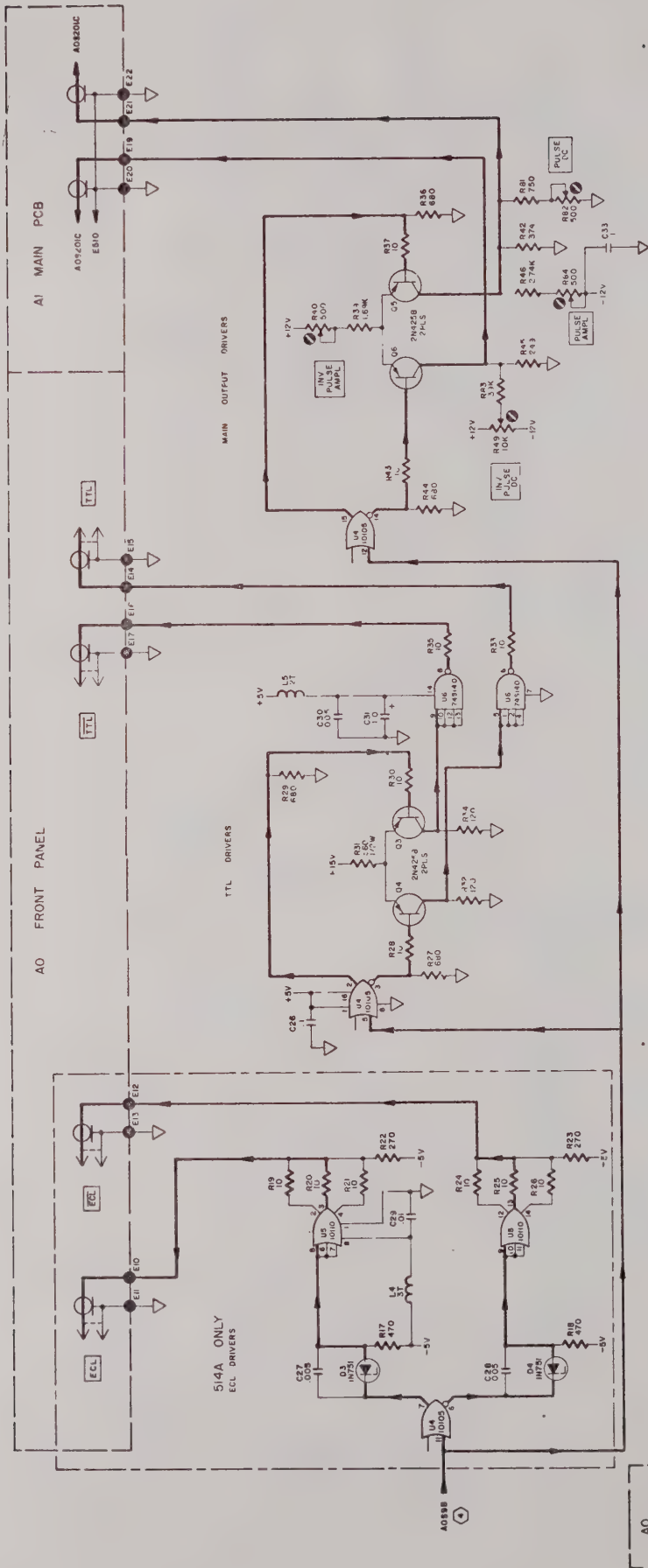
DELAY GENERATOR

PULSE GENERATOR



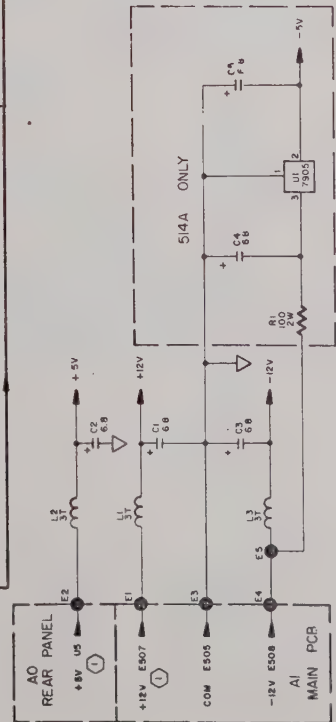
NOTES:
1. SEE SHT 1 (7000714) FOR COMPLETE NOTES.

MODEL 5/4
PULSE GENERATOR
7000717
REV B



NOTES
1 SEE SMT (700074) FOR COMPLETE NOTES

MODEL 514
PULSE OUTPUTS
70-0718
REV A



SECTION 7

ADDENDA

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